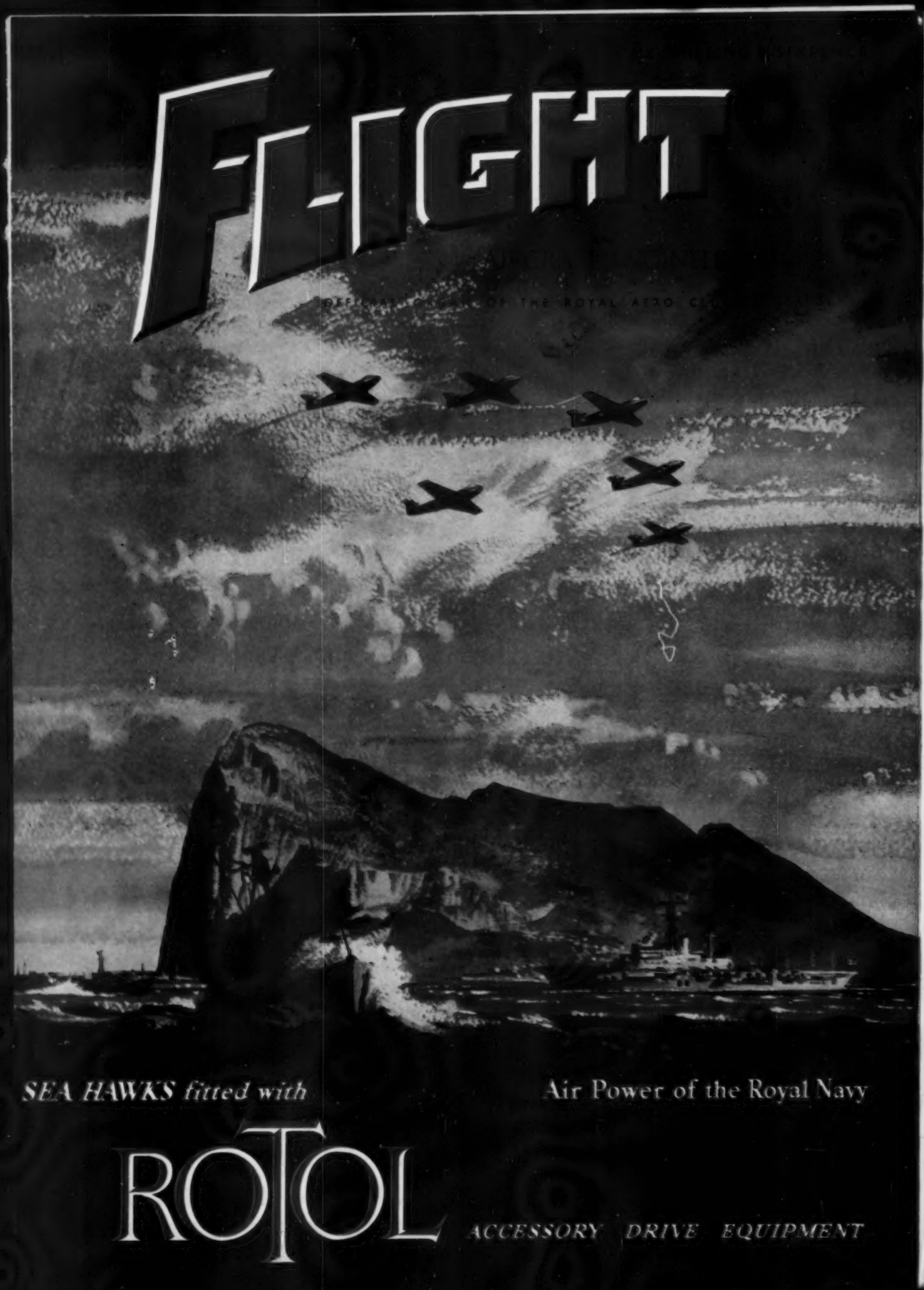
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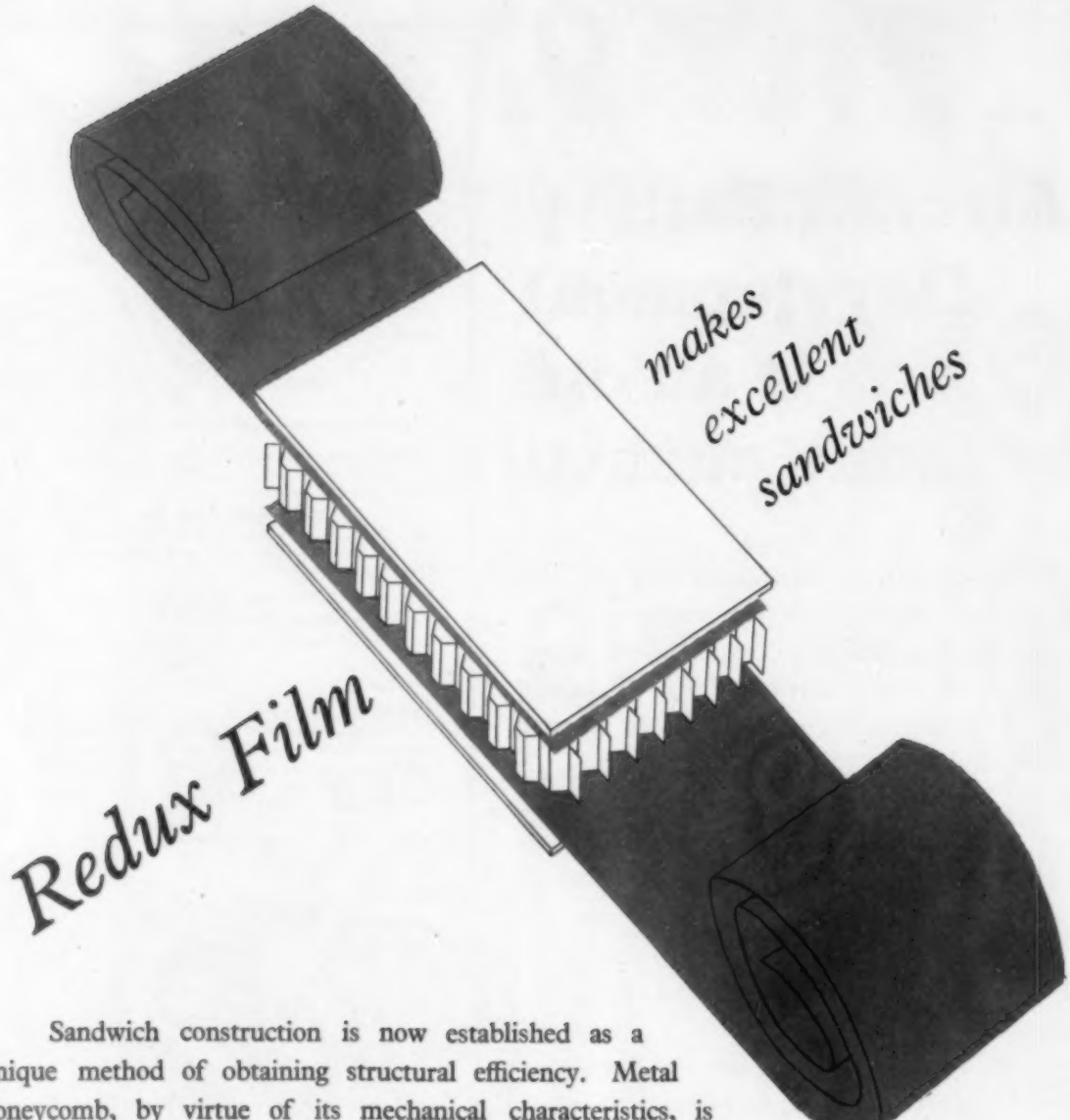

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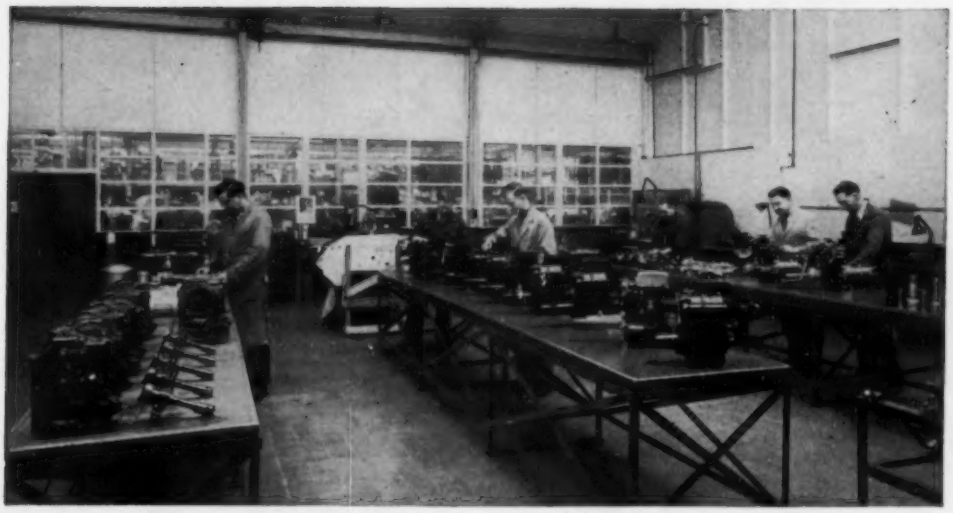

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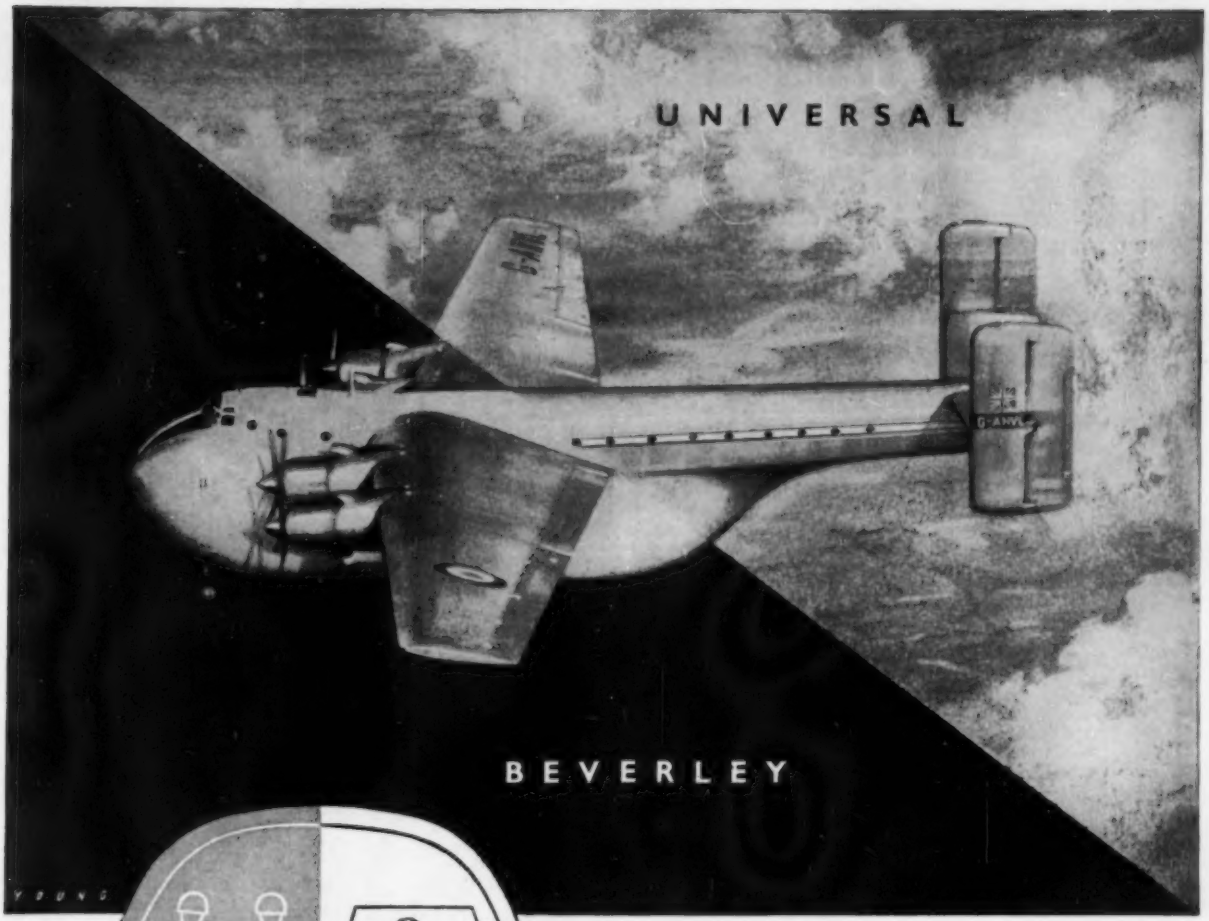

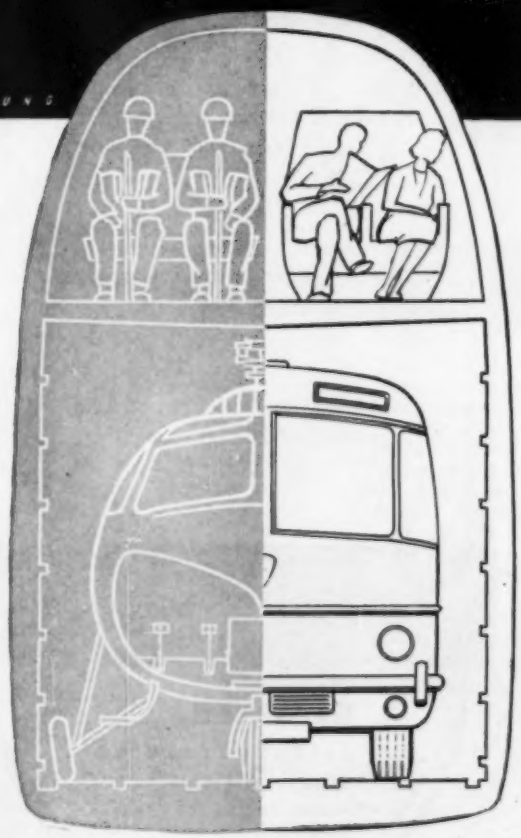

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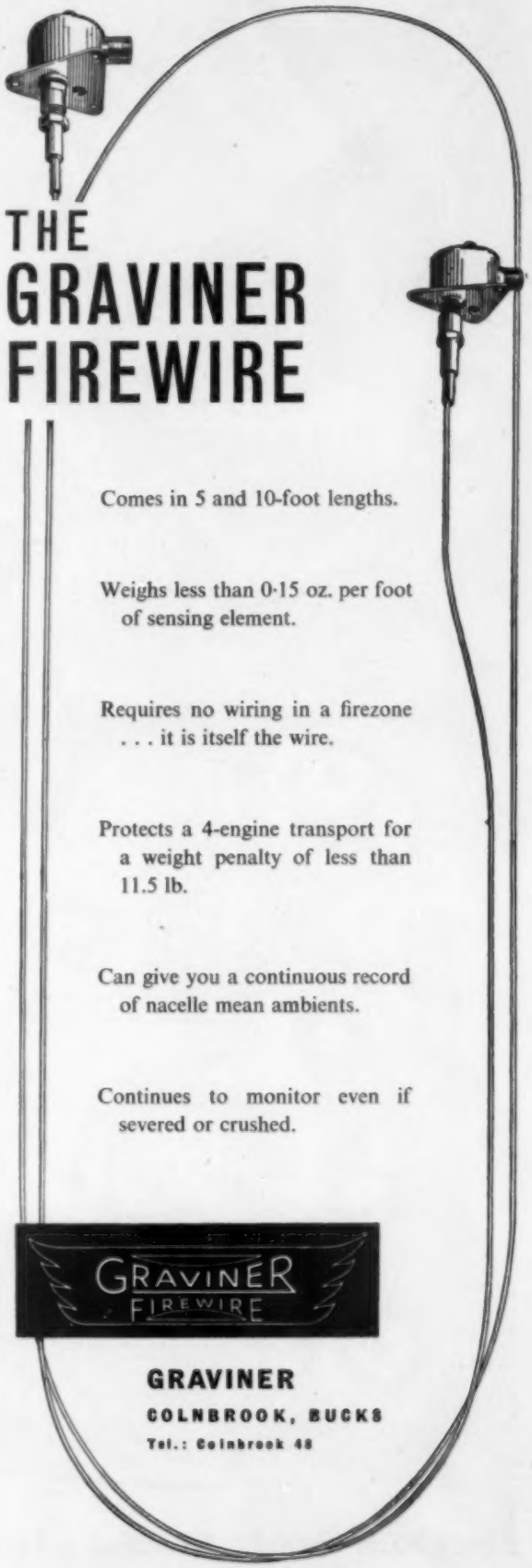

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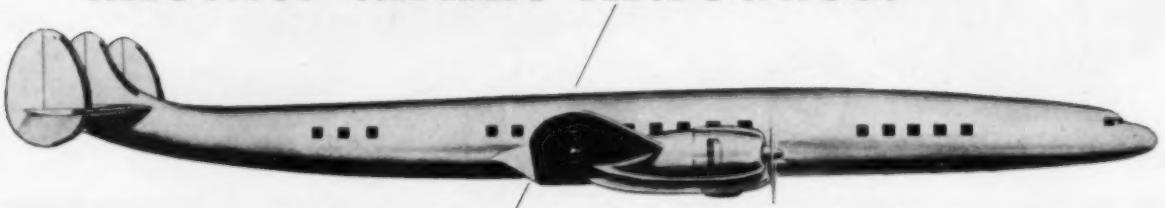

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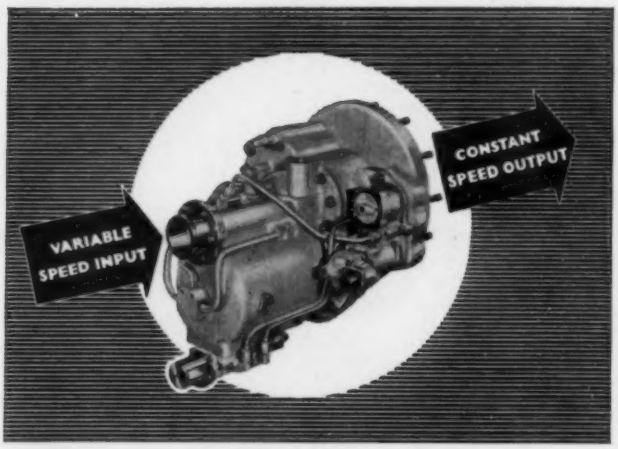

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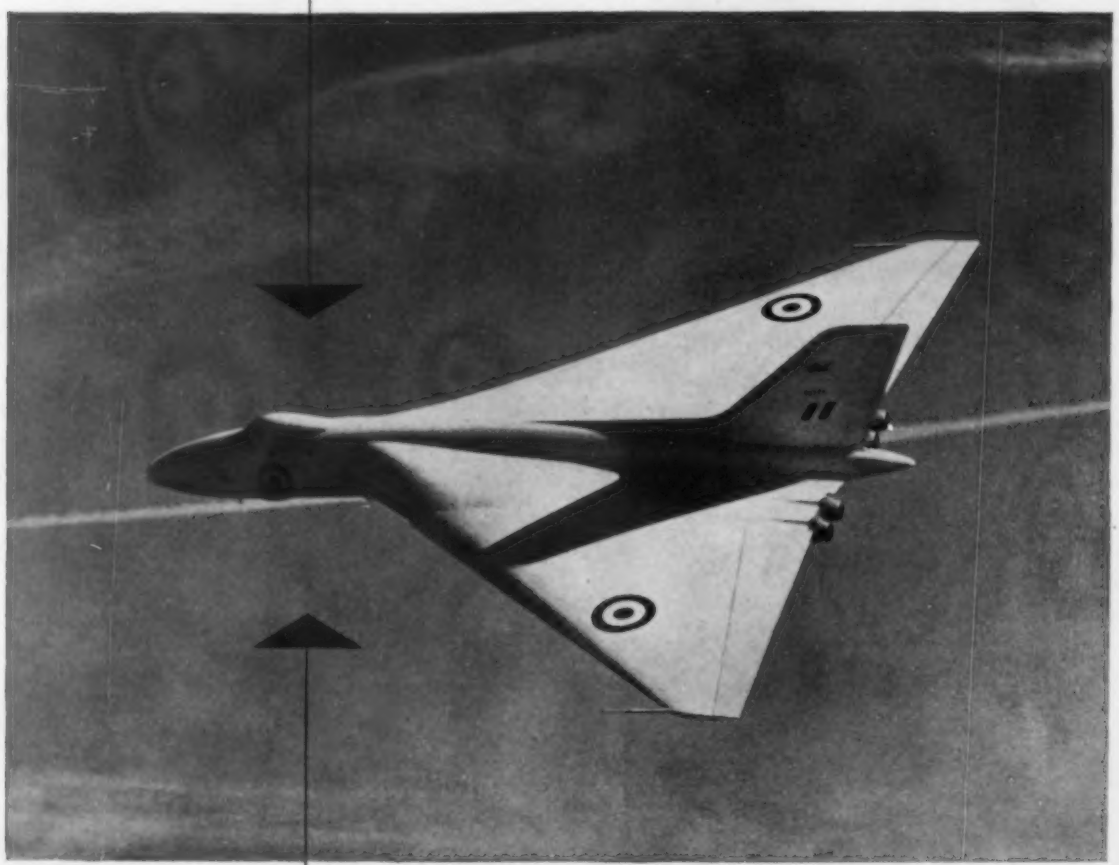

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and
AIRCRAFT ENGINEER

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A New Peril

IT so happened that a question of importance posed in this column last week was authoritatively answered on the day before its publication. We had been musing on the latest Russian fighter and wondering if, in relation to the Hunter, Swift and F-100, it might prove as disconcerting as did the Mig-15 when that Russo-Anglo-Germanic hybrid was first encountered in Korea. Now comes the carefully weighed and officially cleared pronouncement by the U.S. Secretary of the Navy that Russia "has atomic weapons and aircraft faster than sound with which to deliver them"; and, by inference, the supersonic aircraft referred to are fighter/bombers of the new type, for it is hardly credible that the Soviet Air Force can yet be operating "genuine" bombers of like performance.

Though nothing definite is known concerning the new type (for which, in conformity with the official system of nomenclature referred to last week, we propose the name Fright), it should easily exceed a Mach number of 1 on the level. Certainly the necessary thrust is available, for the Bison, Russia's B-52 equivalent, has only half the number of jets fitted to its American counterpart. As for aerodynamics, the all-flying tail has long been common property.

How many of the new fighter/atomic-bombers are serving with the Russian squadrons we have no notion; nor shall we emulate those authorities who make a practice—and quite a comfortable living—of estimating such things (based, of course, on "reliable," but very private, information, smuggled from behind the Iron Curtain). It may be reckoned, however, that a usuable operational force is already in being, whereas the Americans (see page 621 of this issue) are only now delivering the first of their supersonic F-100s to service units.

It has been suggested that, being single-seaters, the Russian fighter/atom bombers will have only a short range; but there is no truth or consolation in this, for grossly overloaded, as they could be for take-off, they might well achieve a radius of action of a thousand miles. America, moreover, has demonstrated with her Ficon system the immense possibilities of air-launching such machines. (By this system a Republic Thunderflash, with a 1,000-mile radius of action is carried by a B-36, itself capable of a 4,000-mile radius.)

For us in Britain the facts are bitter. Our lack of supersonic fighter/atom bombers arouses concern; but that we should be lagging in the development and introduction of intercepters capable of defending us *against* such aircraft is a far graver matter.

Turboproptimism

A WEEK does not pass without some bright new turn in the fortunes of the turboprop. If there is no new order for Viscounts to announce, or no fresh exploit by the Britannia, then the Americans come forward with some such achievement as the recently disclosed climb to 30,000ft or more by the great Convair Tradewind flying boat (one of many American prototypes now flying with turboprop power). On the Service side, true, we in Britain have met something of a setback in the temporary grounding of our Fairey Gannets; but overall the prospect is a rosy one, and any doubt on this point is dispelled by this single issue of *Flight*. Herein we record the return of the Britannia from her tropical trials; first details of B.E.A.'s new short-range money-spinner, the Viscount 802; the B.O.A.C./Douglas discussions on a version of the DC-7 with Rolls-Royce RB.109s; and an important lecture wherein the possibilities of gas turbines for helicopters (a turboprop alliance) is discussed with authority and clarity. And going back just one week we find references to several other turbine-engined helicopters, including a "DC-3 replacement" driven by RB.109s.

The most gratifying aspects of the whole good business are that the best—and only—turboprops in service are British; that the finest examples under development are British; and that the most imaginative schemes for their application are British. This, of course, is as it should be, bearing in mind that the first turboprop to fly was (we shun further repetition) a Rolls-Royce product.

FIFTEEN THOUSAND HORSE-POWER, delivered by the four Allison T56 turboprops of the Lockheed YC-130, lift the new prototype for its first flight. The world's most advanced military transport aircraft, this pressurized trooper/freighter for the U.S.A.F. is the second turboprop Lockheed, the first having been the U.S. Navy's R7V-2 version of the Super Constellation. Production C-130As are now on the line at Marietta, Georgia.

FROM ALL QUARTERS

The Duke at Prestwick

DURING a one-day visit to the Glasgow area last week—the third day of his Scottish tour—H.R.H. the Duke of Edinburgh inspected the factory of Scottish Aviation, Ltd., at Prestwick Airport. In the absence of the company's chairman, the Duke of Hamilton, he was met by the other three directors of the company, Mr. David McIntyre (managing director), Mr. T. D. M. Robertson (general manager) and Mr. Robert McIntyre (chief designer) and by Mr. J. M. Gray, Director of Research and Development (Civil Aircraft), M.o.S.

The Duke, who had toured the airport in company with A. Cdre. J. G. Murray, Scottish Controller of the M.T.C.A., spent some time in the cockpit of a Prestwick Pioneer, with Mr. N. J. Capper, the company's chief test pilot; he also inspected the Pioneer production line—where these aircraft are built for use by the R.A.F. in Malaya—and work on the Twin Pioneer prototype.

The landing and take-off performance of the Pioneer were demonstrated to the royal visitor by Mr. Capper, who flew the aircraft from a 50-yd strip marked out on one of the aircraft dispersal aprons.

A Hot Subject

BRITISH research and developments in turbojet thrust-boosting systems have largely remained confidential, and an R.Ae.S. main lecture on the subject entitled "The Development of Re-heat," by Mr. J. L. Edwards (combustion research engineer, the de Havilland Engine Co., Ltd.) is therefore particularly valuable. This paper, which was due to be read before the society in London yesterday, outlines the pros and cons of the principle, traces the history of D.H. work in the field, and draws several noteworthy conclusions. It reveals, for example, that both the Vampires and Venom have flown with re-heat at altitudes greater than 45,000ft and that, on the Venom, successful re-lights have been achieved at 40,000ft. Furthermore, these conditions are approximately as severe as those anticipated on more modern aircraft at 60,000ft. The paper will be dealt with more extensively in our next issue.

Supersonic Bombers, Fighters, Missiles

THE U.S. Secretary of the Air Force, Mr. Harold Talbott, has announced in Washington that the U.S.A.F. has ordered the production of the Convair B-58 supersonic bomber and the Lockheed F-104 jet fighter. The first B-58 will probably fly next year (it will be built by the Convair Division of the General Dynamics Corporation at Fort Worth, Texas) and will be powered by four General Electric J79 turbojets, each of 15,000 lb static thrust. It has been designed as a successor to the Boeing B-47, far more than 1,000 of which have been built. Production of a "Boeing heavy bomber"—evidently the B-52—is being stepped up. Mr. Talbott added that new contracts have, since July 1st, brought the total U.S.A.F. orders for aircraft and related items to more than $1,200 million (£435 million). The F-104—a relatively light fighter having a straight wing and a Wright J65 (Armstrong Siddeley Sapphire) turbojet—has been on test at Edwards Air Force Base, California, since last February.

A speed-up in the production of guided weapons of all types has also been announced in Washington, and Mr. Charles Wilson, the U.S. Defence Secretary, has appointed a committee to survey the entire missile field, including research, development, production, financing and service use. The committee is expected to study the outlook for as far as ten years ahead, when intercontinental missiles should be coming into their own. Recommendations are expected for ending the rivalries between Army, Air Force and Navy in the race for missiles. In the past five years about £250 million has been spent on missiles in America—mostly on research; about £180 million has been appropriated in the present financial year. The Army has just announced that a new long-range rocket—the Redstone—is to be delivered in quantity by the Chrysler Corporation.

British Titanium

AN important development in the production of titanium was announced during a recent discussion between Imperial Chemical Industries, Ltd., and 50 representatives of the aircraft industry. The company disclosed that, following extended research, they had perfected the reduction of titanium tetrachloride by sodium—the method by which the metal was first isolated. It was previously believed that this process would be

uncontrollable on a large scale and could not produce sufficiently good "sponge" to permit good ingots to be made. I.C.I. have found that not only is the process economically attractive but that their product is fully up to requirements in all respects.

A semi-technical plant was erected in 1953 and a larger pilot plant began production this year. The latter has since produced many tons of granules suitable for compression into pellets for melting. Even before the pilot began production, I.C.I. began work on a large-scale plant, with an initial capacity of 1,500 tons a year. This plant is now being built in the North of England.

Sir Charles Medhurst

AS we go to press we learn with regret of the death, at the age of 57, of Air Chief Marshal Sir Charles Medhurst, K.C.B., O.B.E., M.C. Sir Charles, who flew as an R.F.C. pilot in World War I, was Assistant Chief of Air Staff (Intelligence) in 1941 and Vice-Chief of the Air Staff in 1942. In March 1943 he became Assistant Chief of Air Staff (Policy), and was subsequently Commandant of the R.A.F. Staff College. He was appointed A.O.C.-in-C. Middle East Command in 1945 and Air Commander-in-Chief, R.A.F. Mediterranean Middle East Command, in the following October. He retired in 1950.

MR. SELWYN LLOYD, who, in the Cabinet reappointments announced last week-end, succeeds Mr. Duncan Sandys as Minister of Supply. With a distinguished career in the Law and Army (he rose to the rank of Brigadier during the war), he has been Minister of State since October 1951. He is 50 years of age.

Evidence Wanted

IN a quest for evidence concerning the loss of the K.L.M. Douglas DC-6B *Willem Bontekoe* in the North Sea on August 23rd, the Dutch Directorate of Civil Aviation have asked the Royal Netherlands Air Force to submit a series of questions to the air forces of Western Europe. A wing tip fuel tank found near the scene of the crash, which occurred some 17 miles off the Dutch coast, has suggested the possibility that the aircraft may have collided with a jet fighter, and the questions are accordingly phrased as follows:—

(1) Had, on August 23rd, any jet fighter not returned to its base in Western Europe?

(2) Had, on August 23rd, any jet fighter returned to its Western European base in damaged condition?

CUTTLE-FISH attribute of this Martin B-57B is accounted for by the type of propellant used in the starter cartridges of its Wright J65 (Armstrong Siddeley Sapphire) turbojets. The B-57B was about to be demonstrated by O. E. (Pat) Tibbs at Langley A.F.B. Note the tandem-seat clamshell canopy of this latest Canberra variant.

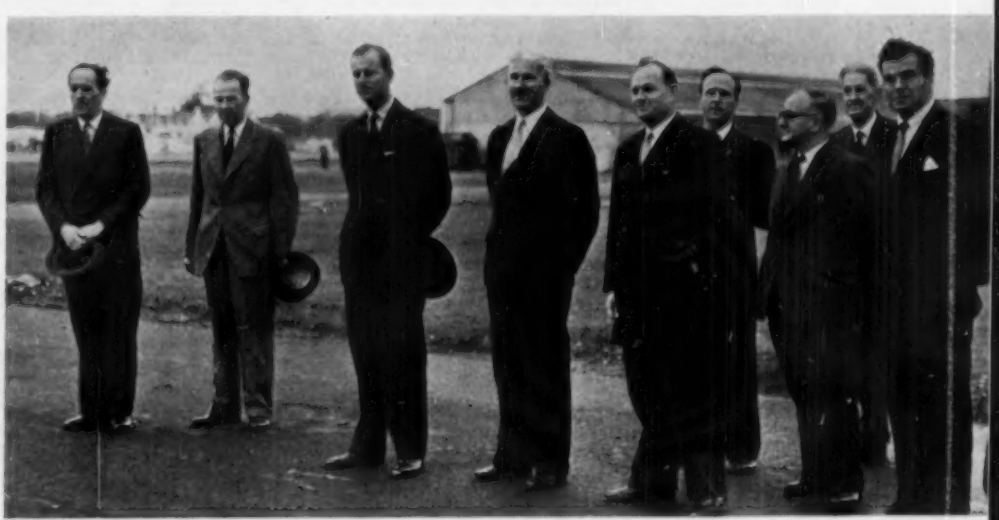
(3) Had, on August 23rd, a jet fighter been in the so-called traffic corridor?

(4) Of which nationality is the fuel tank bearing certain registration marks which has been found in the immediate vicinity of the wreck of the *Willem Bontekoe*?

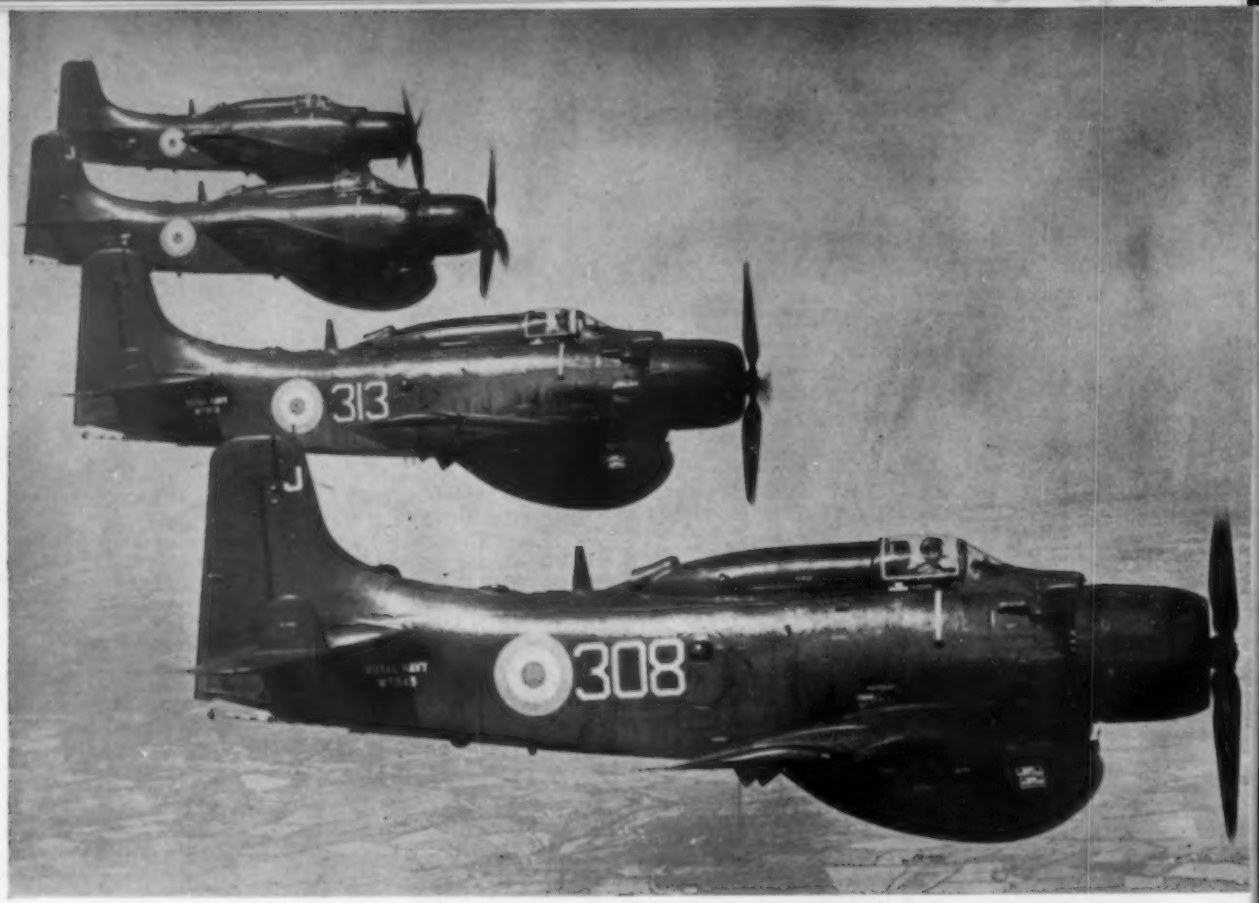
R.Ae.S. President-Elect

THE new president-elect of the Royal Aeronautical Society is Mr. N. E. Rowe, C.B.E., D.I.C., B.Sc., A.C.G.I., M.I.Mech.E., M.Inst.T., F.I.A.S., F.R.Ae.S., Whit.Ex. He will take office as president next May. Mr. Rowe, who is technical director of Blackburn and General Aircraft, Ltd., has had a distinguished career in aircraft engineering. After an apprenticeship in marine engineering, and service in the First World War, he joined the Royal Aircraft Establishment at Farnborough in 1924. He thereafter occupied technical posts of increasing responsibility at the R.A.E., A. and A.E.E., and Air Ministry. At the outbreak of war, he was Assistant Director of Technical Developments at the Air Ministry, and in 1941 was appointed Director of Technical Development at the Ministry of Aircraft Production; in 1945 he became Director-General. In 1946 he was appointed controller of research and special developments to British European Airways Corporation, a post which he held until he took up his present appointment at the end of 1951.

Mr. N. E. Rowe.



ROYAL VISITS in Scotland. Left, the Duke of Edinburgh at the new Ferranti research laboratories with Mr. J. N. Toothill, general manager, on the left of the picture (see story on page 610). Right, at Prestwick (l. to r.) A. Cdre. J. G. Murray, Controller, Scottish Division, M.T.C.A.; the Lord Lieutenant of Ayrshire, Cdr. G. H. Hughes-Onslow; the Duke of Edinburgh; Mr. David McIntyre, managing director, Scottish Aviation, Ltd.; Mr. T. D. M. Robertson, general manager; Lt. Cdr. Michael Parker, Private Secretary to the Duke; Mr. Robert McIntyre, chief designer, Scottish Aviation, Ltd.; Mr. J. M. Gray, Director of Research and Development (Civil Aircraft), M.o.S.; and S/L. B. P. T. Horsley, Equerry to the Duke.



NAVAL EARLY-WARNERS

No. 849: A Unique Fleet Air Arm Squadron

THE aircraft depicted on these pages are in many ways unique; so also is the unit to which they belong. Not the least of their peculiarities is the fact that their sole *raison d'être* is to provide a means of lifting super-powerful radar sets into the sky.

The wave propagation from a radar scanner is essentially linear and, if the equipment can be lifted high above the earth, it can "see" many times the area than can be covered by a scanner at sea level. The conception of a set with a peak power of about a million Watts (it closely parallels the mast-head radar of warships) carried in an airborne radar station is known as early warning, for it can provide a fleet with very full information about all that is going on within a vast radius. The technique of putting so powerful a set into a small, carrier-based aircraft was developed by the U.S. Navy during, and after, World War 2.

Initially using Grumman TBM-3W Avengers (the suffix W indicating "warner"), the U.S. Navy realized all the advantages that were expected. It was found that not only could the set "see" enemy aircraft and ships (including the periscopes of submerged submarines) at great distances—sometimes before the aircraft could itself be picked up—but the radar picture could be televised back to the friendly fleet and there used directly for plotting; furthermore, the early-warning aircraft could be used as an aircraft-control and direction post in its own right.

Today, most airborne early warning radar is carried by that versatile and rugged war-horse, the Douglas Skyraider, powered by a Wright R-3350 Cyclone. The best-known version of this machine is the AD-4W, and a useful number of these excellent aircraft has been supplied to the Royal Navy under the Mutual Defence Assistance Programme. In the Fleet Air Arm they are styled Skyraider A.E.W.1 (airborne early-warning); before outlining the method of their employment some notes may be necessary to put this aircraft in its proper place.

Actually the Skyraider is quite a large aircraft. The wing area is no less than 400 sq ft, and this helps to explain the fact that the type has, on occasion, lifted a load considerably greater than its empty weight of about 10,500 lb. In transport form, up to 16 passengers have been carried in the centre fuselage. Operational Skyraiders have a large fuel tank amidships and some attack versions are single seaters. "Clean" versions (certainly not an early-warner) are good for as much as 365 m.p.h.

If one discounts the huge "Guppy" fairing under its tummy, the Skyraider looks quite conventional—almost archaic, in fact. Actually it is a most interesting aeroplane, and one which has at the moment no equal and no successor; in fact, if its crews (both British and American) are to be believed, it is just about the optimum machine for the early-warning rôle. In parenthesis, reference may be made to the Lockheed Neptune (which carries the same radar set) and the mighty Super Constellation radar picket, which cruises at 30,000ft with a crew of 31; but neither of these can operate from a carrier.

In spite of its homely appearance the Skyraider typifies, to a high degree, the American way of doing things. The pilot's canopy, for example, is driven by an electric-hydraulic circuit controlled by five-position switches. The ailerons and elevators are hydraulically boosted to keep stick forces low—a boon on a long mission. An electric screw-jack actuates the tailplane incidence; the wheel brakes are hydraulically boosted to three times pedal force; the pilot's seat is electrically adjustable over a wide range of positions; a Bendix (Eclipse-Pioneer) P.1 autopilot is fitted, together with a stick-shaking stall-warning device; and, to cap the lot, each crew member (pilot and two radar operators) has a built-in ashtray. . . .

Features peculiar to the early-warning Skyraider are wing slats and auxiliary tail fins. The scanner itself is housed in what was, at the time of its design, the biggest thing ever attempted in moulding dielectric plastics. This great dome, over six feet across, can stand quite rough treatment; and, surprisingly, it has not impaired the Skyraider's fine handling qualities.

The decision to supply these aircraft to the Fleet Air Arm was taken in 1951, and it was taken for the simple reason that we had no aircraft of our own that could do the job. The first batch of four aircraft arrived by sea in November 1951 straight

FLIGHT PHOTOGRAPHS

The big midnight-blue aircraft of 849 Squadron are a familiar sight over Cornwall, where all these photographs were taken. The group of aircrew are wearing their U.S. Navy headgear, which incorporates a boom-type microphone.

from the El Segundo factory. They were ferried down to H.M.S. *Seahawk* (R.N.A.S. Culdrose, Cornwall) where they formed the nucleus of 778 Squadron, under the command of Lt. J. D. Treacher, R.N. This officer had, with other selected personnel, completed a three-month intensive course on the Skyraider in the U.S.A. Their terms of reference were simple, but they meant a lot of hard work. They were to bring the Skyraider into British service as a fully operational type with proven techniques; they were to train fresh crews; they were to complete carrier trials; and they were to act as the administrative centre from which operational early-warning flights, as they were worked up, would be posted to carriers or other bases.

We first visited the unit in the summer of 1952 and found them in high spirits. Lt. Treacher had discovered that, working in flights of four, sixteen aircraft could maintain a standing patrol of one flight throughout the 24 hours of each day over an extended period. Carrier trials had been completed in *Eagle*, then newly commissioned, and considerable simulated operational flying had been done, partly in conjunction with the Joint Anti-Submarine School (then at Eglinton) and with H.M.S. *Harrier* (R.N.A.D.S. Kete*). Exercise Castanets had shown that the early-warning procedure could be effectively integrated into the normal search-and-reporting network. In fact, the only trouble seemed to have been a shortage of sufficiently powerful ground-testing equipment.

We next visited the Skyraiders in May last year. Several changes were at once apparent. The establishment of aircraft had greatly increased; in fact, there were six Skyraiders in the circuit when we arrived, and many more were parked. Again, the squadron had been re-numbered 849, the move into the eight-hundred series indicating that it was no longer a second-line training unit but a first-line operational squadron. To match his commitments, we were glad to see, the C.O. had been promoted to lieutenant-commander. He told us, among other things, that operational flights were being formed as fast as possible. Two were then worked up and a further two were to be formed in the summer of 1953. The availability of serviceable aircraft had remained excellent.

Since that visit No. 849 has had a change in command. The new C.O., Lt-Cdr. M. J. Baring, R.N., found the squadron a most efficient unit, and under his direction it has continued to expand until it is today probably the largest single operational squadron in any British Service. The headquarters flight continues to be based at Culdrose, but some of the squadron's flights have completed extended training and exercise periods at sea, and the total number of Skyraiders on the Squadron's strength is impressive.

During the past year, one flight has been based in Malta and has taken part in all Mediterranean exercises operating either from R.N.A.S. Hal Far or from a carrier. In September last year one flight embarked in *Eagle* for Exercise Mariner, and 849 Squadron Skyraiders then operated from this carrier at intervals until May of this year, when the ship became due for re-fit. Two recent local exercises in which the squadron took part were Drake's Drum (March 1954, defence of Plymouth) and Millstrike (July 1954, defence of Milford Haven).

Altogether the squadron seems to be exceptionally free from troubles; they have a very responsible job and they know that they can do it. Only one fly seems to be in the ointment, but it is, if metaphors may be mixed, a long-term fly: that Marshall Aid will not continue indefinitely, and this country should not be dependent upon it for a vital type of operational equipment. The specialized early-warning aircraft is here to stay, and the Skyraider has set a challenging standard.

**R.N.A.D.S.—Royal Naval Aircraft Direction Station.*

HERE AND THERE

F.D.2 Progress

THE Fairey Delta 2 made a further successful series of test flights last week, in the hands of its makers' chief test pilot, G/C. R. G. Slade. The aircraft was illustrated in our previous issue.

Sound Initiation

A SUPERSONIC bang was heard for the first time in Queensland when F/L. T. Berry demonstrated an Avon-Sabre during an Air Force Week Display at Amberley R.A.A.F. Station, near Brisbane.

WS-51 Visits Spain

ON Wednesday last a Westland S-51 was due to leave Yeovil on a goodwill flight to Spain—the first journey ever made by helicopter between the two countries. It is hoped that General Franco will fly in the machine when it visits his residence at Prado. From Spain the WS-51 will fly on to give demonstrations in Portugal. The pilot is Mr. John Fay, and he is accompanied by Mr. W. W. Hinks and Mr. G. J. Coombs, both of Westland Aircraft.

S. of S. in Canada

LAST Saturday the Secretary of State for Air, Lord De L'Isle and Dudley, V.C., left London Airport on a visit to aircrew training schools and aircraft factories in Canada. He was accompanied by Mr. T. C. G. James, his Principal Private Secretary, and S/L. J. E. S. Hill, D.S.O., his Personal Air Secretary. The Minister is also to visit a number of U.S.A.F. bases, at the invitation of the American Secretary for Air.

Cayley Memorial Lecture

THE first Sir George Cayley Memorial Lecture, under the auspices of the Brough branch of the Royal Aeronautical Society, is to be given on November 4th as a "main" R.Ae.S. lecture. It will be delivered by Capt. J. Laurence Pritchard, C.B.E., Hon.F.I.A.S., Hon.F.R.Ae.S., at the Royal Station Hotel, Hull, at 7 p.m. On pages 612-613 of this issue will be found some notes on certain aspects of Sir George Cayley's experimental work 150 years ago.

Inst. Nav. A.G.M.

THE INSTITUTE OF NAVIGATION is holding its annual general meeting on Friday next, October 29th, at the Royal Geographical Society. Afterwards, there will be a reception on board H.Q.S. *Wellington*, the headquarters ship of the Honourable Company of Master Mariners.

Mr. R. H. Coverley

WE regret to learn of the death, at the age of 69, of Mr. R. H. Coverley, C.B.E., who was adviser on engines and airscrews to Lord Beaverbrook when he was Minister of Aircraft Production. Mr. Coverley had been a senior executive of Rotol, Ltd., and, earlier, experimental superintendent at Rolls-Royce, Ltd., Derby.

Netherlands Helicopter?

THE Dutch Helicopter Foundation, a private organization headed by Ir. J. Meyer Drees is studying the possibility of building a prototype helicopter. No details will be divulged until it is reasonably certain that the design will be airworthy. There are at present only five helicopters in regular use in Holland; four of them—three S-55s and one S-51—belong to the Navy while the other, a Hiller UH-12B, is operated by a publicity firm.

Sorry You've Been Troubled

THE following news item from Japan deserves quotation as received: "The first post-war domestically-developed aviation engine, the Kawasaki manufactured KA-E engine with 240 T.O. horsepowers, has been seen an accident after a 33-hour 40-minute test runs. The accident was crack of crankshaft after 33-hour 40-min. test runs with damages of rear dynamic damper mounting arms and 6th connect-rod. It also was found that 4th main shaft and 5 and 6th piston skirts have been troubled."

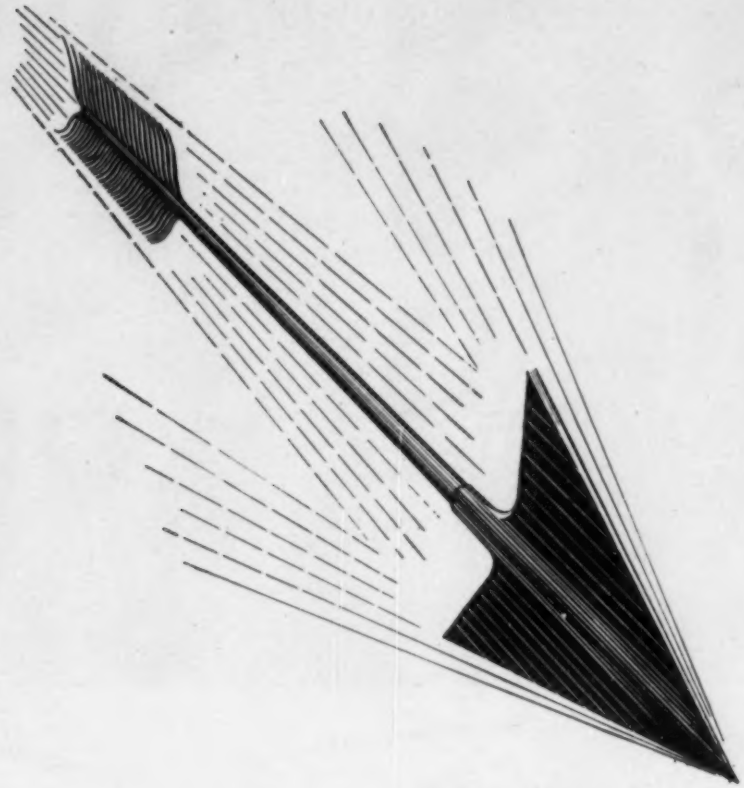
FRANCE, TOO, is studying the application of turbojet power to vertical take-off; this was disclosed at the last Aero-Club de France meeting by the Secretary of State for Air, M. Diomede Catroux. Depicted is a SNECMA rig for research on the application of the Atar to V.T.O. designs by the same company.

For Looking Up

THE index for Volume LXV of *Flight* (January to June, 1954) is now available, price 1s 1½d including postage, from Iliffe and Sons, Dorset House, Stamford Street, London, S.E.1. An index and binding case together cost 6s 4d, with postage, or readers' copies can be accepted for binding at 18s 10d, a price which includes case, index and return postage.

PERUSAL: (Left) General Enrique Bernales, Peruvian Air Minister, studies photographs of Bristol Freighter loading arrangements set out in the cargo hold of one of these aircraft. His mentor was Mr. W. R. Farnes, sales manager of Bristol's Aircraft Division. The General saw Britannia, Freighter and helicopter production.

MORNING CONSTITUTIONAL by Mr. John Profumo (centre), Parliamentary Secretary to the Ministry of Transport and Civil Aviation, Mr. E. C. Wheeldon, managing director of Westland Aircraft, Ltd., and Sir George Cribbett (right), Deputy Secretary to the Ministry, at Yeovil last week. Mr. Profumo and Sir George Cribbett had flown from the South Bank, London, in the WS-51.



HIGH AERODYNAMIC EFFICIENCY

The Eland is an aero-engine giving high power at low cost. It is a single-shaft propeller-turbine developing 3,000 e.h.p. at take-off, with a diameter of only 36 inches. This compactness makes for high aerodynamic efficiency. Other notable features include smooth, surge-free acceleration, low specific weight and low fuel consumption. All in all, the Eland is an impressive example of design and manufacture at the service of commercial aviation.

NAPIER Eland

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PHOTOGRAPH BY AERO FILMS

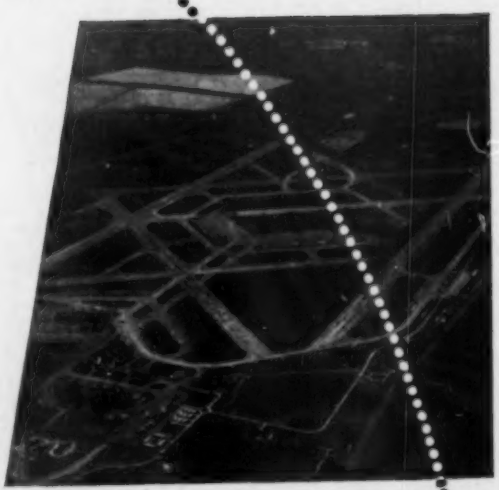
SOUTHAMPTON

TO LONDON AIRPORTS

50 minutes in a BEA armchair

BEA now operate a new service between Southampton and London Airports with Bristol 171 Helicopters. This service links Southampton with the North of England, Scotland and Northern Ireland more rapidly and conveniently than ever before. It also, of course, links the Southampton area directly with BEA's international flights from London Airport.

The Bristol 171's that bring Southampton so comfortably close to London all use BP Aviation Gasoline.



PHOTOGRAPH BY AERO FILMS

BP **AVIATION GASOLINE**

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DISTRIBUTORS IN THE UNITED KINGDOM FOR THE SHELL, ANGLO-IRANIAN AND EAGLE GROUPS.

GAS DYNAMICS LABORATORY

The D.H. Engine Company's New Test Station, Recently Completed at Hatfield

BEFORE the prototype of any new engine can be constructed the company concerned must undertake an exhaustive programme of component-testing. In the case of the gas turbine this period of initial development is greatly facilitated by the fact that engines of this type can be divided into three principal sections, each of which can be examined or test-run on its own. The first section is the compressor, and its testing requires an adequate supply of shaft power as well as means for admitting and exhausting the airflow produced. The second is the combustion system, the testing of which demands an enormous supply of compressed air. The third section is the turbine, which can be tested either cold (requiring the same air supply as the combustion system) or hot (in which case a vast flow of hot gas is necessary).

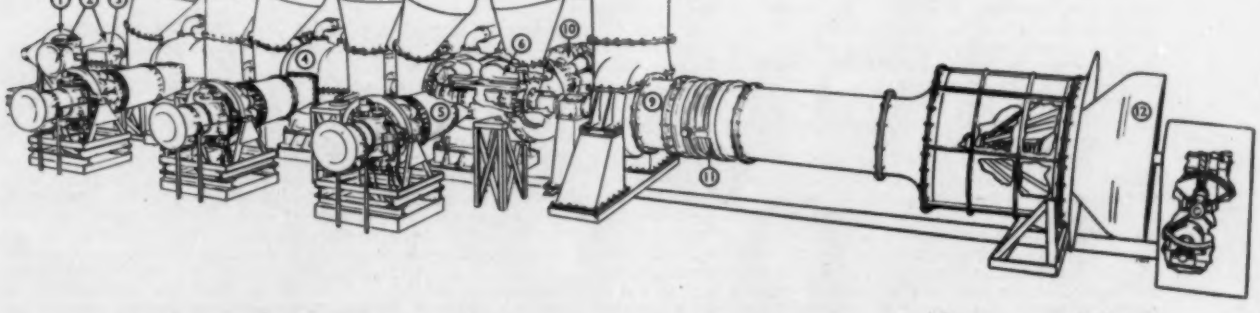
The principal difficulty in meeting these requirements is that everything needs to be provided on the grand scale. Even an engine like the Goblin consumes over 60 lb (or over 750 cu ft) of air each second, and the latest axial turbojets demand three or four times as much. Both the Goblin and the Ghost were designed without the aid of a comprehensive D.H. laboratory, although a flow and combustion test house was built after the war, and was in use by 1949. The establishment included the Bellis and Morcom and the Reavell "house" compressors shown in the diagram overleaf, and fully met the requirements at the time of its construction. Before long, however, additions and improvements were called for.

At this period the de Havilland Engine Company were formulating the design of the Halford H.4 turbojet. This was to be an axial engine much larger and far more powerful than any other turbojet then built. Its development was clearly going to need test and research facilities with a capacity far greater even than that provided by the expanded installation, and the decision was taken about two years ago to extend the plant further, converting the establishment into a single Gas Dynamics Research Laboratory capable of handling the testing of H.4 components and also capable of ready extension to meet the needs of even later developments. This is the building which can be seen at Hatfield today.

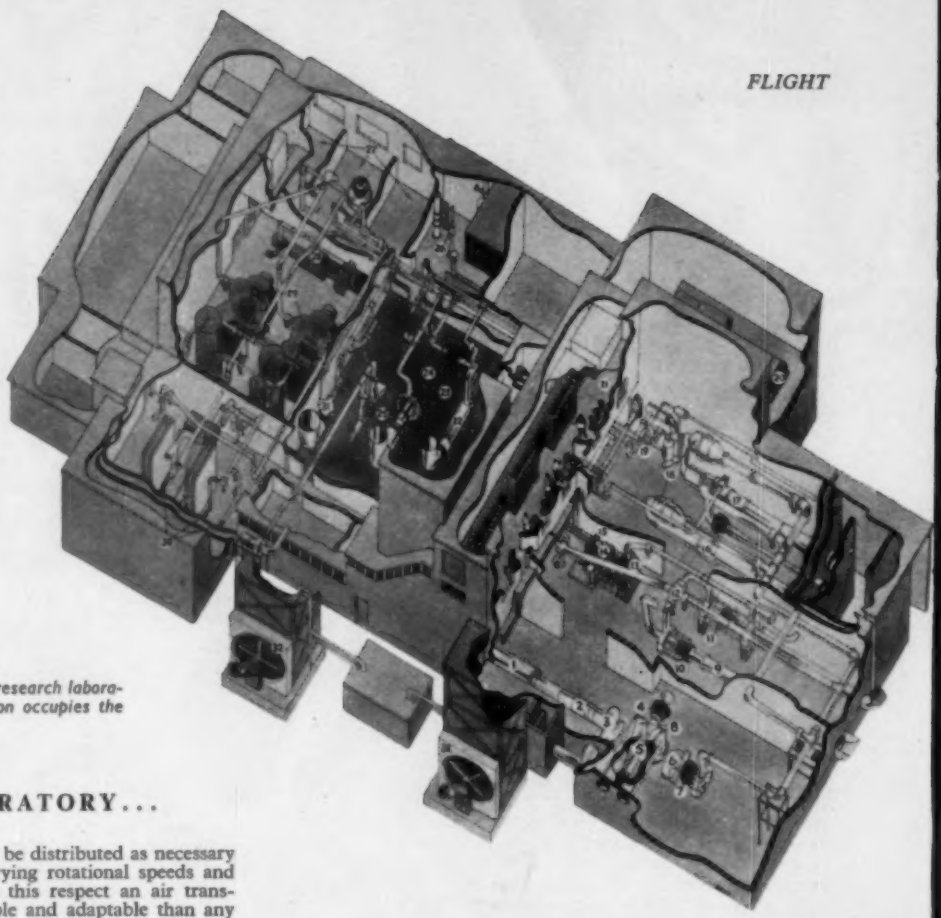
Before taking this decision a careful examination was made to see whether or not full-scale testing was justified. For example, if scaled-down tests of components of a large engine were possible the results could be obtained for the expenditure of no more than modest power. The difficulties of model testing are many, and involve uncertain Mach- and Reynolds-number corrections, and such factors as tolerances and finish. It was decided that the advantages of full-scale testing outweighed the size of plant required, and plans were therefore put in hand to make provision for testing full-size axial compressors, annular combustion chambers and turbines.

One of the first decisions to be taken was on the manner in which the shaft power for compressor testing would be obtained. When it is appreciated that the full-power sea-level testing of a large axial compressor may require 50,000 h.p., the magnitude of the task is apparent. The three methods which suggested themselves were steam turbines, electric motors, or aircraft gas turbines specially adapted to such an installation. It was concluded that in any case it would pay to convert the power into a

Future requirements for the compressor test rig will be met by employing three double-Ghost installations producing some 30,000 h.p., as shown here. 1, Slave Ghost compressor; 2, slave compressor intake; 3, gearbox; 4, power turbine unit; 5, engine exhaust system; 6, water-cooled turbine casing; 7, exhaust collector; 8, test compressor exhaust; 9, instrument section; 10, slave Ghost engine; 11, test compressor; 12, intake throttle valve.



(1) Test compressor intake.
(2) Test compressor.
(3) Test compressor exhaust.
(4) Slave Ghosts driving power turbine (showing first pair installed).
(5) 10,000 h.p. turbine.
(6) Gear drive to slave Ghost compressor.
(7) Slave Ghost compressor.
(8) Power turbine exhaust.
(9) Test rig for single-stage axial compressor.
(10) Modified Ghost for single-stage rig.
(11) Ghost driving turbine test rig.
(12) Air to slave Ghosts.
(13) Turbine test rig.
(14) Reduction gearbox.
(15) Dynamometer.
(16) Test annular combustion chamber.
(17) Test combustion chamber segment.
(18) Air pre-heaters for combustion rig.
(19) Thermocouple rigs.
(20) Brown-Boveri h.p. "house" compressor.
(21) Control room.
(22) Annular chamber test rig.
(23) Combustion rig pre-heater.
(24) Ghost compressor test engine.
(25) Airflow test rigs.
(26) Hydraulic analogy laboratory.
(27) Airflow test cells.
(28) Reavell house compressor.
(29) Bellis and Morcom house compressor.
(30) Combustion chamber rigs.
(31) Annular chamber rig.
(32) Water cooling towers.



Layout of the de Havilland gas dynamics research laboratory. The original part of the installation occupies the upper left area.

GAS DYNAMICS LABORATORY...

supply of compressed air which could be distributed as necessary to numerous test rigs running at varying rotational speeds and with or without combustion, and in this respect an air transmission seemed to be far more flexible and adaptable than any form of mechanical drive.

It was finally decided to adopt the gas-turbine scheme, using de Havilland Ghost turbojets as gas producers discharging into specially designed power turbines. Each Ghost could thus be adapted to provide approximately 5,000 s.h.p., and designs were prepared for a standard unit consisting of two Ghosts each discharging into a water-cooled power turbine delivering about 10,000 s.h.p.; furthermore, the turbine couplings were so arranged that additional units could be ganged to a common shaft to provide, for example, 30,000 h.p. with three such units.

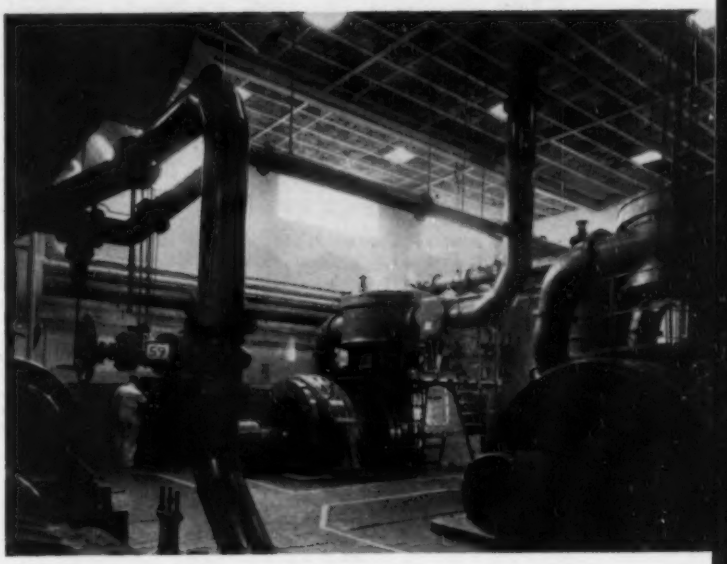
One such power turbine unit is sufficient to drive a Ghost compressor at full duty, and a slave compressor of this type is accordingly fitted on the end of the shaft to supplement the delivery from the existing house compressors by as much as 80 lb of air per second at 60 lb/sq in gauge. Large compressors can be tested on this installation by throttling the intake, thus simulating operation at altitude. Alternatively, the characteristics can be examined by running the compressor in a closed circuit with reduced density at both inlet and delivery. By this means even the largest compressor envisaged can be tested and a check made on the influence of Reynolds number on compressor performance. The air in such a circuit has to be refrigerated and, by using a series of coolers and expanders, the de Havilland installation can be run at −50 deg C.

In general, investigation of an axial compressor or turbine is facilitated by considering the unit one stage at a time. This procedure would be largely a waste of the equipment just described, for the latter is better employed in testing complete units. Furthermore, the full-scale plant would entail delay and would not have sufficient operational flexibility. Supplementary plants have therefore been built specifically for the testing of single axial stages of both compressors and turbines. Basically each subsidiary compressor rig consists of a Ghost from which the compressor has been removed and to which combustion air is supplied by the house compressors. The existing Ghost turbine can then be used to provide an output of 4,000 s.h.p. at speeds up to 10,000 r.p.m., which admirably suits the requirements of large single-stage test units.

The installation for testing turbines differs from the compressor rig in that the original Ghost compressor is retained and employed as a vacuum pump which draws air through the turbine on test. The output from the test turbine is then absorbed by a calibrated dynamometer. The air passing through the test turbine is cooled owing to the extraction of energy by the turbine. If sufficient power is removed from the flow, the temperature will fall below freezing point and the normal moisture content will be deposited within the ducting as snow and ice. As a counter-measure, some of the outlet from the Ghost compressor—180 - 200 deg C hotter than the intake—is ducted back upstream of the test turbine.

The control room has been comprehensively equipped with quick-reading instruments and automatic recorders in order that the running time of all high-power sections may be cut to a minimum.

The installations just described are suitable for component examination prior to the construction of a new engine. Once a complete prototype engine is available it is possible to check the matching of the main components (compressor, combustion system and turbine) by a method specially developed by the Engine Company. In normal, steady running all the power from the turbine of a turbojet is exactly absorbed by the compressor, and the operating conditions of each are so arranged that each works near its point of peak efficiency. An exact balance is not immediately achieved and it is common practice to adjust the capacity of either the compressor or turbine until optimum performance is obtained. This can be done with assurance if the matching point is determined during actual running and the true



The upper view shows the first pair of slave Ghosts driving a 10,000-h.p. turbine connected to a slave compressor (foreground) and a large axial compressor (obscured by the exhaust uptakes). In the lower illustration is seen the original installation of Bellis and Morcom electrically driven "house" compressors, the output from which has since been augmented by that from the slave Ghost compressor above.

characteristics established on either side of the operating point.

The effect is readily achieved by varying the flow through the turbine independently of the compressor delivery. In the Hatfield establishment air from another compressor is fed into the combustion system of the test engine through pipes welded to the outer casing. This raises the pressure downstream of the engine compressor and causes the characteristic of the latter component to move towards the surge line, while the additional air passes through the turbine, reducing the temperature throughout the turbine section. Alternatively, air can be bled from the engine compressor through the same ducting, in which case the characteristics are extended below normal; normally this would tend to overheat the turbine and, to give the same range of operation, the final nozzle, or possibly the whole tail-pipe, has to be removed.

The company have now applied this method to a number of engines with very successful results. The method is made possible by the fact that the entire range under examination can be covered by injecting or extracting a relatively low percentage of the total mass flow.

In the testing of combustion systems two aspects are important: full-throttle examination under sea-level conditions and tests at altitude. In all cases the merits of the chamber are assessed by measuring the pressure-drop, combustion efficiency, and uniformity of temperature across the outlet. The individual can-type combuster as used in the company's centrifugal engines can be tested completely with the air from the house compressors. The same equipment is adequate for testing sections of modern annular chambers under sea-level conditions; now, using the enormous output from test compressors, the largest annular combustion chambers can be tested over their complete range of operating conditions. In passing, it is worth noting that the H.4 engine is now being developed as the Gyron, and it may be concluded that by far the greatest load on the establishment described in these pages is now directed towards the development of this one type. The Gyron has now been running for over two years, and promises to be an invaluable power unit, particularly for supersonic flight.

In full-scale combustion testing the heat liberated is enormous and, as a safeguard against excessive metal temperatures, all sections of ducting and any valves in the high-temperature parts of rigs are of robust construction and have water cooling; water is also sprayed into the exhaust gases before the latter are admitted to the silencing chambers.

Some of the subsidiary rigs in the new building are investigating fuel vaporization rates, the injection of sprays into hot gas flows, ignition problems and flame stabilization. It is probable that some of this work is directed towards the development of reheat systems for turbojets, although the latter are normally developed almost entirely with the aid of the associated engine itself. It is possible that the company are at work on ramjet development, although no public statement to this effect has been made.

The cost of running an establishment of this nature is such that great efforts have been made to provide accurate and quick-reading instrumentation so that high-power running can be kept to a minimum. The need for this is underlined by the fact that, in order to measure the combustion efficiency and pressure-drop in a big annular combustion chamber, over 2,000 individual readings may be required. The company have developed automatic mechanisms such as controlled traversing, by means of which temperature and pressure variations at many points are simultaneously charted. The perfected technique is showing reductions in running time of the order of 90 per cent.

The new de Havilland laboratory was planned almost entirely by the Engine Company itself, together with the plant engineer of the de Havilland Enterprise. The Enterprise carried out the construction of the building and developed many of the installations, using such equipment as Callender's Cables, Heenan and Froude dynamometer, Demag gear box, Foster and Budenberg gauges, and Lucas and Rotax electrical and combustion equipment.

The establishment comes under the direction of Dr. E. S. Moult, the company's chief engineer, and the conception of the Ghost/power-turbine compressor test plant is mainly attributed to his deputy, Mr. F. M. Owner. In charge of the department is Mr. J. L. Edwards, who, with Dr. P. H. Calder and Mr. I. H. Blick, was responsible for much of the general layout and technical supervision.

INTERIOR LIGHTING AT L.A.P.

ORDERS placed with the General Electric Co., Ltd., for lighting the workshops and offices of the new B.O.A.C. headquarters at London Airport are stated to constitute the largest contract yet awarded in this country for the illumination of a single building; the value of the order is £86,000 to date.

The workshop area, 830ft long and having a 90ft roof span with a maximum height of 44ft, will be illuminated by five rows of cold-cathode fittings, ceiling-mounted in the main span and forming almost continuous runs from end to end of the building. A Delaron plastic reflector is fitted behind each unit. Similar four-tube fittings with Delaron reflectors are installed at 20ft centres in the aisles, and standard vapour-proof fittings for 5ft 80W hot-cathode tubes are installed for lighting test benches below two elevated office blocks at each side of the shop area.

There is a special installation in the telephone exchange, where twin-tube fittings are mounted continuously along the top of the switchboard and provide general lighting by reflection from the ceiling, while a special reflector system directs light on to the panels themselves.

NEW ALDIS LAMP

AT a reception held on board H.Q.S. *Wellington* in the Thames on October 7th, Aldis Brothers, Ltd., introduced their new Mk X long-range signalling lamp. This equipment, which replaces the well-known Aldis lamp produced with only minor modifications for the past 38 years, is five times more powerful than the earlier type, and it allows a greatly increased speed of signalling. It weighs only 4½ lb, can be fitted with a variety of filters, and has alternative telescopic and peep-sight aiming gear. It is claimed that the performance of the new lamp exceeds that laid down in Ministry of Transport and Civil Aviation specifications, and that sizeable orders for it have already been placed.

ELECTRONICS AT EDINBURGH

Aviation Importance of Ferranti's New Research Laboratory

AS part of this country's defence programme, an extensive amount of Government-sponsored research and development work is being carried out at present by private companies. Especially in the field of electronics, this is mainly carried out in the southern and midland counties of the United Kingdom, for reasons which include the present location of Government research establishments. The opening of a modern and well-equipped research laboratory at Crewe Toll, Edinburgh, on October 11th, gave an indication of the successful joint efforts of the Scottish Council (Development and Industry), Ferranti, Ltd., the Ministry of Supply and the Admiralty to enable Scotland to share in the growth of this young electronic industry.

Ferranti's original factory at Crewe Toll was built during the war to produce the gyroscopic gunsight, then a new instrument. The remarkably short interval of one year elapsed between the decision to build the factory and the delivery of the first gunsight. Initially covering 100,000 sq ft, the premises were continually expanded up to 1952, since when further expansion has taken place at Dundee and Granton, together with the establishment of an apprentices' school at Leith. The new laboratory block, which was opened by the Duke of Edinburgh, now increases the total area by 60,000 sq ft.

The functions of the new laboratory are not confined to the work of the Ferranti company, although its Edinburgh design and development staff are housed there. Under the Scottish Council Electronics Scheme, the laboratory will be a central source from which parts of large-scale development projects will be subcontracted to smaller teams from other firms. In addition, Ferrantis will provide guidance and training in electronics for engineers of these other companies, up to 40 of whom can be accommodated. The techniques of electronics are therefore being acquired by Scottish firms under the stimulus of Government development projects and with the support of the Ministry of Supply, which sponsored the construction of the new block.

At a luncheon in Edinburgh prior to the opening, the president of the Scottish Council, Lord Bilsland, introduced Mr. Duncan Sandys, Minister of Supply. Mr. Sandys said that his Ministry owned no less than 24 factories in Scotland which directly employed over 20,000 people. These included the Ministry's factory at East Kilbride, where Rolls-Royce aero-engines were being made. In addition, many M.o.S. contracts were being placed in Scotland for defence equipment and for development work. The new Ferranti electronic laboratories, he said, were the biggest and most up-to-date in Scotland: the large financial contribution which the Ministry of Supply had made to the capital cost of the building was evidence of the importance they attached to it.

At the opening ceremony that afternoon, the Duke of Edinburgh was introduced by Sir Vincent de Ferranti, M.C., chairman and managing director of the company, who gave credit for the initiation of the Scottish Electronic Scheme to Mr. J. N. Toothill (general manager).

The Duke of Edinburgh, officially opening the laboratory, said that if anything could make this island safe from attack it would be the brains and imagination of our electronic scientists and research engineers. "Electronics for defence," he went on, "must have a high priority but electronics for industry must come a close second. As a manufacturing country our export trade depends on our ability to make things that nobody else can make, and to make things better and cheaper than anyone else. To this end we must bend all our ingenuity and resources. The electronic industry is most important in itself, but it is even more important in the help it can offer to every other industry in the form of process and machine tool control.

"Even so, the human output of this laboratory may prove to be even more valuable to Scotland than the work which may be done here. By a unique partnership between Ferranti, the Admiralty, the Ministry of Supply, the Scottish Council and several Scottish firms, it will train and send out to firms all over Scotland electronic engineers with a thorough knowledge of the latest techniques and discoveries. Men and ideas will go out from here to help the industry of Scotland and to help bring security to Great Britain."

An aid to flying—strictly non-electronic—was presented to the Duke by Mr. Toothill as a souvenir of the occasion. It was a specially made leather map-case, complete with maps. This, Mr. Toothill pointed out, would enable His Royal Highness to fly "so much better, so much safer." The Duke was then escorted on a tour of the new laboratories.

The aeronautical emphasis at Crewe Toll is illustrated by the fact that some 90 per cent of the activities of Ferranti's development team of 600 people is devoted entirely to providing equipment for aviation. The four main departments are the radar laboratory, the instrument laboratory, the vacuum physics laboratory and the applications laboratory, and there is also a large team known as the trials and installation division whose function is to carry out flight trials and assessments on particular systems.

The company's distance measuring equipment (airborne interrogator Mk 2) was the main exhibit in the radar laboratory. This is of the 1,000 Mc/s type specified by I.C.A.O., and comprises the main unit (transmitter, timing system and receiver), control unit, aerial and the presentation instrument. The power output of the transmitter is 4 kW, and the 10 transmitter frequencies of the 100-channel system are each stabilized to within ±0.4 Mc/s by reference to fixed cavities. Dimensions of the main unit are only 12in × 8in × 12½in.

The receiver, which has a gain of 117 decibels below 1 Watt and a band width of 1.5 Mc/s, has its 10 discrete frequencies stabilized to within ±0.25 Mc/s. An optional feature on this unit is the provision of a homing facility which makes the Ferranti D.M.E. a complete short-range navigational system if V.O.R. is not available.

The omni-directional aerial used for both transmission and reception can be either of suppressed or external type. Homing aerials when required are used for reception only, and are normally suppressed and mounted on either side of the nose of the aircraft. The presentation unit is the standard 3½in diameter instrument showing a 0-200-mile exponential scale covering a 270-deg arc.

A number of measurement and test techniques used in association with the company's D.M.E. were also demonstrated in the laboratory. These included two systems of radio-frequency standing wave detection, an automatic frequency control unit which can maintain the frequency of the D.M.E.'s co-axial line oscillator to plus or minus one part in 4,000 over a wide temperature range at spot frequencies from 950 to 1,050 Mc/s; and a magnetostriction delay line by means of which the pulse spacing in the ground beacon is achieved.

Also on view was an aircraft echo simulator used in the training of air traffic controllers. The controls of this equipment are in the form of a pilot's cockpit controls; they are operated under the instructions of the ground controller, and on the controller's radar display an echo signal is produced which moves in accordance with the simulated movement of the aircraft.

An interesting piece of apparatus developed to solve a specific design problem was a radiation-pattern recorder used in conjunction with model aircraft to plot the radiation characteristics of aircraft aerials. Due to the shape and position of an aircraft's wings, engine nacelles and tailplane, distorted radiation patterns can be produced, and the mathematical calculation of the behaviour of an aerial becomes very difficult. The determination of an optimum aerial position for a particular application would therefore be almost impossible without resorting to actual

The new Ferranti research and development laboratory at Crewe Toll, Edinburgh, officially opened on October 5th.

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ELECTRONICS AT EDINBURGH . . .

measurement. Experiments with full-sized aircraft either on the ground or in flight are generally impracticable, and so the solution has been found in the use of models in which both aircraft dimensions and operating wavelength are reduced by the same factor. The models are mounted on the roof of the laboratory and by choosing a suitable suspension system, free-space conditions can be closely realized.

Gyroscopic gunsights were the first product of Ferranti's Edinburgh factory and, not unnaturally, the emphasis was on gyroscopes and gyroscopic applications in the instrument laboratory of the new block. The most modern types of gunsight could not be shown, but a representative gyro sight was exhibited, together with test equipment for its dynamic calibration. A number of vertical gyros were on view, and a demonstration was given of the dynamic characteristics of a rate gyro. A feature of the Ferranti rate gyroscope is that the gyro frame is not mounted in bearings but in a cross-spring pivot, which provides both suspension for the system and the necessary restraint. Long life is claimed to be the main advantage arising from this development.

A dynamic balancing machine for gyroscope rotors, based on the principles devised by Professor Arnold, of Edinburgh University, was demonstrated. The rotor to be tested is mounted at the free end of a horizontal torsion bar. Should the rotor be out of balance, it will tend to twist the bar, the amplitude of vibration being displayed optically on a screen. Stroboscopic lighting of the rotor enables the out-of-balance point to be seen.

Also shown in the instrument laboratory was the company's airstream direction detector, which measures either sideslip or angle of attack (depending on whether the probe unit is mounted horizontally or vertically). The probe contains two axial slots 90 deg apart. Any difference in dynamic air pressures on the slots causes a rotation of the probe to the balance position when the slots are symmetrically placed with respect to the local airflow. An indication of the angular movement of the probe is obtained from an electrical pick-off, and the pilot's indication is given either by means of a scale and pointer or by the operation of coloured lights. A small wind tunnel built to assist the development and calibration of this instrument is also installed in the laboratory.

For accurate measurement and testing of instruments, a special room is used in which the temperature and humidity are controlled to within close limits, and all dust particles greater than five millionths of an inch in size are eliminated. It contains a work table mounted on a pillar which has separate foundations in order that vibration-free tests may be made. Climatic and durability testing chambers have also been provided, to simulate extremes of temperature and humidity, severe vibration and shock, as part of the test procedure to which completed equipment is subjected.

The Ferranti company is undertaking a comprehensive programme of development in the field of machine-tool and industrial process control, with the object of improving production methods by employing electronics in place of human operators of machines. The main advantages are reductions in time and cost, together with improved accuracy and efficiency. The aircraft industry is obviously one in which electronic control can prove particularly valuable.

The general principles of the company's approach, together with examples of machining by electronic control, could be studied in the applications laboratory. A digital computor is used; as it has to deal with a limited number of clearly defined functions, this industrial computor can be of simpler construction and operation than most digital computors made in the past, which have mainly been universal machines capable of doing complex mathematical calculations of many types. The computor is linked to an associated system of measurement and control, and has been designed so that one of a number of predetermined programmes or logical patterns can be selected (and, if necessary, modified).

The whole system comprises five main sections. Firstly, a tape perforator is used by the planning engineer to instruct the computor to perform the operation required. This involves coding the dimensions of the article and machining instructions as perforations on a strip of paper tape. A tape reader then transfers the instructions coded on the tape to the computor. The computor itself takes this basic information and calculates precisely the movements which the table of the machine tool will need to make in order to cut the required shape. The fourth component is a magnetic tape recorder which records the instructions for these movements, and finally there is the machine tool itself, complete with tape controlled servo mechanisms and measuring devices which move under the control of the tape play-back unit.

The measurement system is based on the use of optical gratings (carrying 5,000 lines to the inch), photo-electric cells, and an electronic counting circuit. Thus the movement of the work table in three mutually perpendicular directions can be measured to an accuracy of one line, or 1/5,000in, which is in fact a higher accuracy than the basic milling machine is capable of obtaining. Thus a higher practical accuracy is possible with improved machines in future; the present system is capable of machining to an accuracy as high as that obtainable by a human operator, but at a much greater speed.

The Ferranti trials and installation division operates a number of aircraft on flight trials of various items of equipment, and includes in its staff pilots and maintenance engineers. At the new laboratory, facilities are provided for the recording and analysis of the flight trial work, a large proportion of which is concerned with air firing and the testing of gunsights, in addition to the evaluation of electronic equipment.

The vacuum physics section of the laboratory is primarily devoted to the development of highly specialized valves, but is also associated with other projects involving vacuum techniques.

Many of the items on view in the new laboratory emphasized the fact that there is a great deal more to research and development than merely the production of a working piece of equipment. In association with work on specific projects it is necessary for a development team to study and develop techniques which can be applied generally to design, manufacture and testing. The new premises will enable Ferranti's own research and development work to continue on an increasingly large scale. More than this, the training of engineers from other companies in electronic techniques will create further research teams with new types of experience and knowledge.

FROM M.o.S. TO INDUSTRY

ON October 12th Mr. Ivor Bowen, C.M.G., M.Sc., F.R.Ae.S., A.M.I.E.E., voluntarily retired from the post of Principal Director of Air Equipment Research and Development in the Ministry of Supply, and he now joins the General Precision Equipment Corporation of the U.S.A. as their British Empire representative, resident in London. The G.P.E. group consists of eighteen companies, each specializing in some particular field; among them are the General Precision Laboratory, Inc., Askania Regulator Company, Kearfott Company, Inc., Librascope Inc., and Link Aviation, Inc. Mr. Bowen is well known as having been the first Director of Instrument Research and Development in the Ministry of Supply, subsequently Chief Superintendent of the Aeroplane and Armament Experimental Establishment, Boscombe Down (1947-50) and from 1950 to 1953 Head of the U.K. Ministry of Supply Staff, Australia, and latterly Scientific Adviser to the U.K. High Commissioner, Canberra.

Mr. Ivor Bowen.

His interest in aeronautics dates from his being a founder member of the Cambridge University Air Squadron in 1925. From 1938 to 1940 he was Lecturer in Air Navigation in the City and Guilds College, South Kensington. During the last war he held a commission as honorary group captain in the R.A.F.V.R. He was appointed a C.M.G. in the last Birthday Honours List.

CHRISTMAS-TIME BY THE FORELOCK

READERS who intend to fulfil good resolutions about buying Christmas presents really early may like to be reminded that, as usual, a number of our associated journals are publishing pocket diaries, and that these are now on sale. Each contains a great deal of concise information about many aspects of the subject with which they are concerned. Details are as follows:—

Yachting World Diary, 10s 6d in blue Morocco leather or 7s in Rexine; *The Autocar* Motorist's Diary, *Wireless World* Diary, *The Motor Cycle* Diary, and *Amateur Photographer* Diary, all 5s 10d each in Morocco leather or 4s 1d in Rexine.

For farmers, *Farmer and Stock-breeder* is publishing a series of diaries; prices for various styles are: 4s 3d, 6s 9d, or 10s; there is also the same journal's Young Farmer's Diary at 3s 9d, 6s, or 6s 6d. Those with womenfolk interested in nursing may note that the *Nursing Mirror* Diary can be obtained at 3s 9d or 5s 5d.

All the above diaries are obtainable from stationers or direct from Dorset House, Stamford Street, London, S.E.1. (Postage is extra, except in the case of the last-named diary.)

AERODYNAMICS IN 1804

The Pioneer Work of Sir George Caley

By A. H. YATES

ONE HUNDRED AND FIFTY years ago, in the year before the Battle of Trafalgar, Sir George Cayley (1773-1857) was conducting experiments on the lifting properties of aerofoils. His aim was to learn enough aerodynamics—although the word was not in use until 30 years later—to build himself a flying machine. Realizing the need for systematic data on the lifting power and the weight of various wings, he measured and weighed many representative birds and then undertook a series of tests using an aerofoil on a whirling arm. Cayley followed these tests by building and flying the first known model glider—almost one hundred years before the Wright brothers flew.

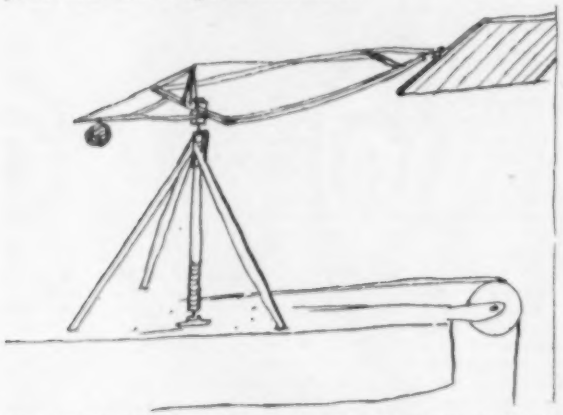


Fig. 1. Cayley's sketch of a whirling-arm for determining the lift of a surface at various angles of incidence.

Cayley's tests are of lasting interest because in his notebook* he recorded carefully the details of his experiments, and we can thus examine his findings in the light of our present knowledge.

Fig. 1 shows the whirling arm on which Cayley measured the lift of a square, flat plate at various angles of incidence. Although whirling arms had first been used sixty years before, this was the first occasion on which they were used to collect basic aerodynamic knowledge. The lift at angles of incidence up to 20 degrees was measured in ounces and the speed by a stopwatch. Although Cayley knew that air forces were proportional to ρV^2, the term "lift coefficient" had not then been invented. Our Fig. 2 shows the whirling-arm results plotted in modern notation and compared with recent theoretical calculations† of the lift on a flat plate of aspect ratio 1. Note the low lift-curve slope, for which the low aspect ratio is responsible, and the concave shape of the lift curve, now explained as due to "part-span vortex sheets".‡ Cayley was convinced that birds used only small angles of incidence, and he made no attempt to determine the maximum lift obtainable from his wing.

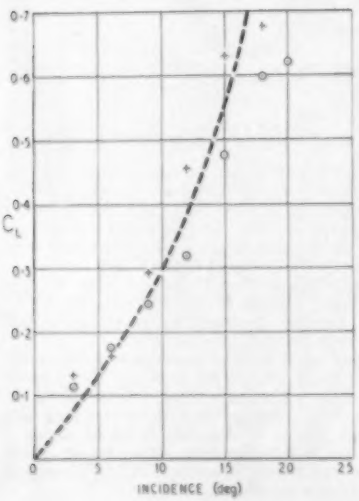


Fig. 2. Lift on a square flat ptate; a comparison of experiment (1804) with theory (1951). The points show Cayley's experimental results at air velocities of 15ft/sec (crossed) and 21.8ft/sec (ringed). They are seen to be in surprisingly good agreement with the curve, which is calculated according to the theory of Flax and Lawrence.

Later entries in the diary show that Cayley's bird studies had caused him to ponder on the effect of wing camber and aspect ratio ("I am apt to think that the more concave the wing to a certain extent the more it gives support, and that for slow flights a long thin wing is necessary"). There is no evidence, however, that he tested other aerofoil sections on the whirling arm. The results quoted showed him that a flat plate would lift one pound per square foot at about 35 ft/sec—a figure already in his mind from his observations of bird flight.

Cayley made many careful measurements of the total weight, wing area, wing weight and gliding speed of birds. Among the birds mentioned in his notebook are the heron, crow, pigeon, grouse, partridge, woodcock, owl, curlew and hawk. He noted that their wing loadings varied from 0.5 to 1.8 lb/sq ft and that a typical gliding speed was 20 m.p.h.

He also found that the wing weight of the crow was only 0.1 lb/sq ft and deduced that a "plain" to carry a man and having an area of 300 sq ft would weigh 30 lb! No square-cube law worried Cayley.

Before attempting to design a man-carrying glider, Cayley made a model (Fig. 3). The first model aeroplane flown, it is featured on the R.Ae.S. British Gold Medal for Aeronautics. It is interesting to compare today's calculations of the trim and stability of such a glider with Cayley's experimental results. He found that the glider flew best with the centre of gravity 7.5in aft of the root leading edge and with the tail setting +11.5 deg. The weight was 3.82 oz and, at the flying speed which Cayley estimated at 15 ft/sec, the wing lift coefficient was approximately 0.7. Allowing for downwash the theoretical tail setting to trim is then in good agreement with the measured 11.5 deg.

Cayley had set the wing at 6 deg to the fuselage and found that it then developed about $C_L = 0.7$. His whirling arm tests (at an angle of incidence of 6 deg) had given $C_L = 0.17$—only a quarter of the glider lift. This discrepancy puzzled Cayley, who did not realize that the glider fuselage was inclined at about 14 degrees

Fig. 3. Sketch for a model glider, the first heavier-than-air device to fly.

to the flight path, giving a wing incidence of about 20 deg and not six as he had supposed. His explanation of the discrepancy was that either a wing gave less lift on the whirling arm than in flight in a straight line or that "the paper on the kite (glider) might not be tight." He knew of crows that "their wing is concave which resists (lifts) much more than a plane surface."

This glider apparently flew very well. Cayley wrote in his notebook: "It was very pretty to see it sail down a steep hill and it gave the idea that a larger instrument would be a better and a safer conveyance down the Alps than even a surefooted mule let him meditate his track ever so intensely. The least inclination of the tail towards the right or left made it shape its course like a ship to the rudder." Although without dihedral the glider had a low centre of gravity position and, with the large cruciform tailplane, had adequate longitudinal and lateral stability.

After his success with this first fixed wing flying machine, Cayley attempted to improve its performance. In 1808 he made a larger model which had cambered wings with dihedral and a larger aspect-ratio. With it he discovered that the centre of pressure of the wing was "much forwarder of the centre of bulk than could be supposed *a priori*."

Cayley now turned his attention to designing a powered aeroplane. He was the first to see that the problem of flight was "to make a surface support a given weight by the application of power to the resistance of the air." The first task was to design

*Sir George Cayley: "Aeronautical and Miscellaneous Notebook" (circa 1799-1826). Published for the Newcomen Society by Heffers, 1933.

†Flax and Lawrence: "The Aerodynamics of Low Aspect Ratio Wings." Third Anglo-American Conference, 1951.

‡Kuchemann: "Types of Flow on Swept Wings." R.Ae.S. Journal, November 1953.

Fig. 4. Cayley's sketch of a man-actuated ornithopter.

a suitable engine. He writes in 1808: "Being in want of a simple and light first mover on a small scale for the purpose of some preparatory experiments on aerial navigation, I constructed one in which the force of gunpowder. . . ." This engine consumed "Hervey's best gunpowder" at the rate of 60 lb/hr/b.h.p. but was "extremely light."

In the same year Cayley was considering the design of an ornithopter—a glider which could be propelled by the pilot once it had been launched into gliding flight (Fig. 4). The inventor proposed to use his own legs as undercarriage and, having measured that he could run at 20 ft/sec, decided that with a wing area of 300 sq ft he would be able to lift 200 lb. (This corresponds to $C_L = 1.4$ and was thus optimistic.) The structure weight "need not exceed 40 pounds at most" so that "with the advantage of a slight declivity" the running pilot should, he considered, be able to seat himself while gliding and then propel the ornithopter by flapping the wings by his arm or leg movements.

There is no record of attempts at flapping flight, although flights of a full-size glider (presumably pilotless) are described. "It was very beautiful," writes Cayley, "to see this noble white bird sail majestically from the top of a hill to any point of the plain below it, according to the set of its rudder, merely by its own weight, descending in an angle of about 18 degrees with the horizon." It is a pity that this development of an aeroplane using such a reliable power plant (propelled "merely by its own weight") was not pursued farther. Eighty years were to elapse before Lilienthal, still awaiting a light power plant, flew the first man-carrying glider and was able to carry out systematic tests in flight on aeroplane stability and control.

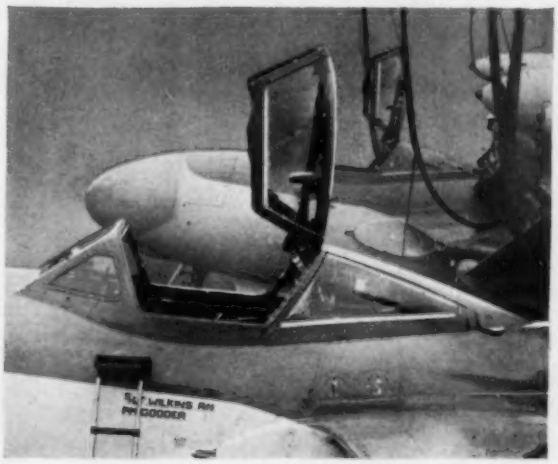
We have recently paid tribute to the work of the Wright brothers who, in the era of express trains and motor cars, built and flew the first man-carrying powered aeroplane. One hundred years earlier Cayley, in a world of stage-coaches, H.M.S. *Victory* and Napoleon, built and flew the first glider. He was well described by Charles Dollfus as "*le véritable inventeur de l'aéroplane.*"

UNDERWATER CANOPY-JETTISON

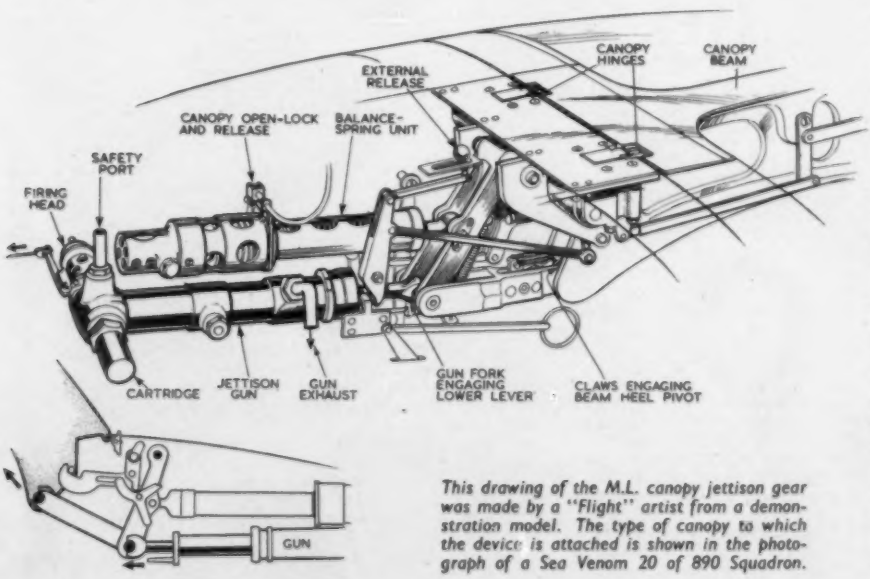
IF a carrier-based aircraft is unfortunate enough to suffer a forced alighting the odds are that it will hit the sea and not land. Furthermore, it is possible that it will sink at once, and this raises problems in the design of canopy-jettison gear. M.L. Aviation Co., Ltd., of White Waltham, Berks, have now developed a mechanism which can be applied to any clam-shell type of canopy hinged at the rear and secured at the front by an orthodox latch. The device is used on the de Havilland Vampire Trainer and Sea Venom, both of which are in squadron service with the Fleet Air Arm.

The M.L. arrangement will not only throw off the canopy in flight but will also force it open even if the aircraft is deeply submerged in water; successful tests have been carried out with a canopy immersed at depths greater than 10ft, in all attitudes, with a total water force on the canopy of over three tons.

The mechanism occupies a small compartment at the rear of the cockpit. Before jettisoning, the forward latch is automatically unlocked and the hinges released; if desired, these operations can also be performed manually to provide servicing access with the canopy completely removed. The forward latch can be operated either from the interior or by means of the external release on the rear starboard side. The mechanism itself can be followed by reference to the drawings. Normal opening and closing of the hood actuates a sliding tube housing compression springs which balance the canopy in any position; in the fully open position the canopy is locked, and can be released only by a lever in the cockpit. The sleeve housing the sliding tube incorporates annular rubber shock-absorbers.



"Flight" photograph



This drawing of the M.L. canopy jettison gear was made by a "Flight" artist from a demonstration model. The type of canopy to which the device is attached is shown in the photograph of a Sea Venom 20 of 890 Squadron.

The jettison gear is provided with full safety devices; for example the thrust plate, at the forward end of the gun, is in contact with a push rod which operates the claw mechanism and with the shoe which operates the bell-crank linkage (seen in front of the balance-spring unit), so that if the gun fires accidentally, or without operation of the emergency release, the canopy will be thrown off. The gun exhaust tube allows the gas from the cordite cartridge to escape when the gun piston has reached its full stroke; for pressurization purposes, this port is sealed by a light safety disc. A second, high-pressure, safety port is provided above the breech, as an overload pressure-release.

MOBILITY IN READINESS

Some New Thoughts on the Creation of an Air Transport Reserve

By Lt-Col. P. A. TOBIN

A RECENT pronouncement by the Chief of the Imperial General Staff expressed in official language the conviction, felt for some while by air-minded soldiers, that the solution to the Army's supply problems in war lies very largely in the extended use of air transport.

By the end of the 1939-45 war, it was already obvious that the effort in man-power and road transport required for the administrative support of our land forces had reached a quite disproportionate level, which could lead only to eventual stagnation.

Since that time, the advent of atomic and hydrogen weapons has immensely aggravated the problem. Land and sea communications—particularly ports and bases—are critically vulnerable to the new weapons. In the face of these threats, an army in the field can be maintained only if the chain of supply no longer passes down closely congested channels from bottleneck to bottleneck, but is replaced by a web of communications spread over a wide area, collecting from factories or depots, and delivering as nearly as possible directly to the users along the battle fronts. Such a system can be provided only by air transport.

It has been authoritatively stated that, with sufficient air transport capacity, we could stock our overseas bases and maintain our forces in the field without using sea or rail transport for any but the heaviest and most unwieldy loads. Similarly, by the use of helicopters or other aircraft possessing near-vertical lift, the road system in a theatre could be relieved of all but the transport of fighting formations and certain ultra-heavy loads.

Of course, the key to this statement is the phrase " . . . with sufficient air transport capacity," and it is the purpose of this article to suggest means whereby this capacity can be provided in both peace and war.

In this country the size of our military forces is controlled by the extent of the financial and manpower resources that we can afford to allot to our defences. At the present time any bid by the Army for a share of our aircraft and aero-engine potential would conflict with the large-scale re-equipment of the Royal Air Force with modern types of combat aircraft. Such is the complexity and expense of modern aeroplanes that even relatively few of these machines must absorb the greater part of the R.A.F. vote for many years to come.

The second problem to be overcome is that of manning a transport fleet on the scale envisaged. The R.A.F. receives a strictly limited quota of the nation's manpower, and will require all of this to man the vital fighter, bomber, maritime and tactical components, leaving only a bare minimum for the less urgent transport rôle. Moreover, it would be difficult to justify the maintenance in peace of a transport force on the scale required by the Army in the event of war. Nevertheless, a transport lift of some size must, in present-day conditions, be considered an essential part of our military assets. It is not necessary to stress the lessons of Berlin, Korea, Abadan, Egypt and Kenya to show that, in the Cold War, a strategic reserve which can be moved at short notice to any part of the world must be a vital component of our strategy.

Transport Command's Equipment

It is thus clear that in peace-time Transport Command can provide only a fraction of the air lift that would be required on, or even before, the outbreak of another war. Furthermore, in order to meet its peacetime commitments, the Command will necessarily be composed mainly of strategic transport aircraft—such as the Vickers 1000—suitable for moving small formations of lightly armed troops at high speeds over long distances. Such aircraft must of necessity operate from fully developed bases with long runways, and are not ideal for the carriage of heavier weapons and stores. To meet this latter commitment the Ministry have ordered the Blackburn Beverley, but so great is the expense of building these large aircraft, that their numbers must be reckoned in tens rather than in the hundreds that would be urgently required by war.

It thus seems that, while Transport Command will shortly be able to provide the nucleus of an efficient transport fleet, there is an urgent need for a reserve of transport aircraft and crews which can be rapidly made available in the event of emergency, in so-called peace as well as war. Such a reserve can only be found from our civil air resources, either the big corporations or from the private operators.

Inevitably, the aircraft operated by B.O.A.C. and B.E.A. must be mainly those designed for the primary function of carrying fare-paying passengers in safety and comfort over long or short stages between fully developed airports. Therefore these aircraft—Comets, Britannias, Viscounts, Ambassadors and their successors—will suffer from the same limitations as have been mentioned for the Vickers 1000. Useful as they may be in supplementing the passenger carrying capacity of Transport Command in war, they can make little contribution towards solving our major problem.

There remain the independent air transport operators. At first sight these may seem to be of even less value. They operate a miscellany of older aircraft such as Dakotas, Vikings, Yorks and Hermes. While many carry freight, few of the aircraft were designed for military loads; their capacities are generally limited, and the practical problems of operating so diverse a collection of obsolescent aircraft would be formidable. If however, these operators were equipped with aircraft which would, in general, meet the military requirement, then they would provide the obvious source of our reserve transport fleet. The problem is whether it is possible to produce aircraft which can meet equally satisfactorily the demands of both the military and the civil operator.

The basic military requirement is for a general-purpose transport aircraft capable of carrying men, vehicles or stores when operating from small undeveloped strips or fields. In particular it must have the following characteristics:—

(a) Be able to carry vehicles up to the size of the 1 ton combat truck, field artillery and bulky stores.
(b) Be capable of rapid loading and unloading.
(c) Be suitable for heavy dropping of vehicles and stores.
(d) Be suitable for dropping paratroops.
(e) Be suitable for troop-carrying.
(f) Good take-off and landing characteristics using small, undeveloped strips or fields anywhere in the world.
(g) Good slow-flying capabilities for parachuting.
(h) Be simple and robust for world-wide operation with the minimum of maintenance by ground staffs.
(i) While normally required for short-haul, high-capacity work, should be capable of using extra tankage for increased range in a reinforcing rôle.

Finding a Useful Compromise

We thus get a picture of a simple, rugged aircraft with a large capacity fuselage, wide rear doors for loading and parachuting, and with good low speed and take-off qualities. It will be noted that speed and ceiling are of secondary importance. As to size, large aircraft would undoubtedly be the more economical to operate. On the other hand, a larger number of smaller aircraft gives more flexibility in employment, avoids having "too many eggs in one basket," and escapes the problems of handling very large aircraft on small strips. A reasonable compromise would appear to be the largest payload that can be built into a twin-engined aircraft, while retaining the essential take-off and landing characteristics. In view of the moderate ceiling and speed requirements, and the need for robustness and simple maintenance, piston engines are clearly indicated. If therefore we design our theoretical aircraft around two piston engines of 2,800/3,000 h.p.—the most powerful available in this country—we should be able to provide an aircraft of 55,000 - 60,000 lb a.u.w. with a payload of at least 20,000 lb over 500 miles, and probably more over shorter stages. Such an aircraft would carry about 60 troops and any of the military loads so far specified.

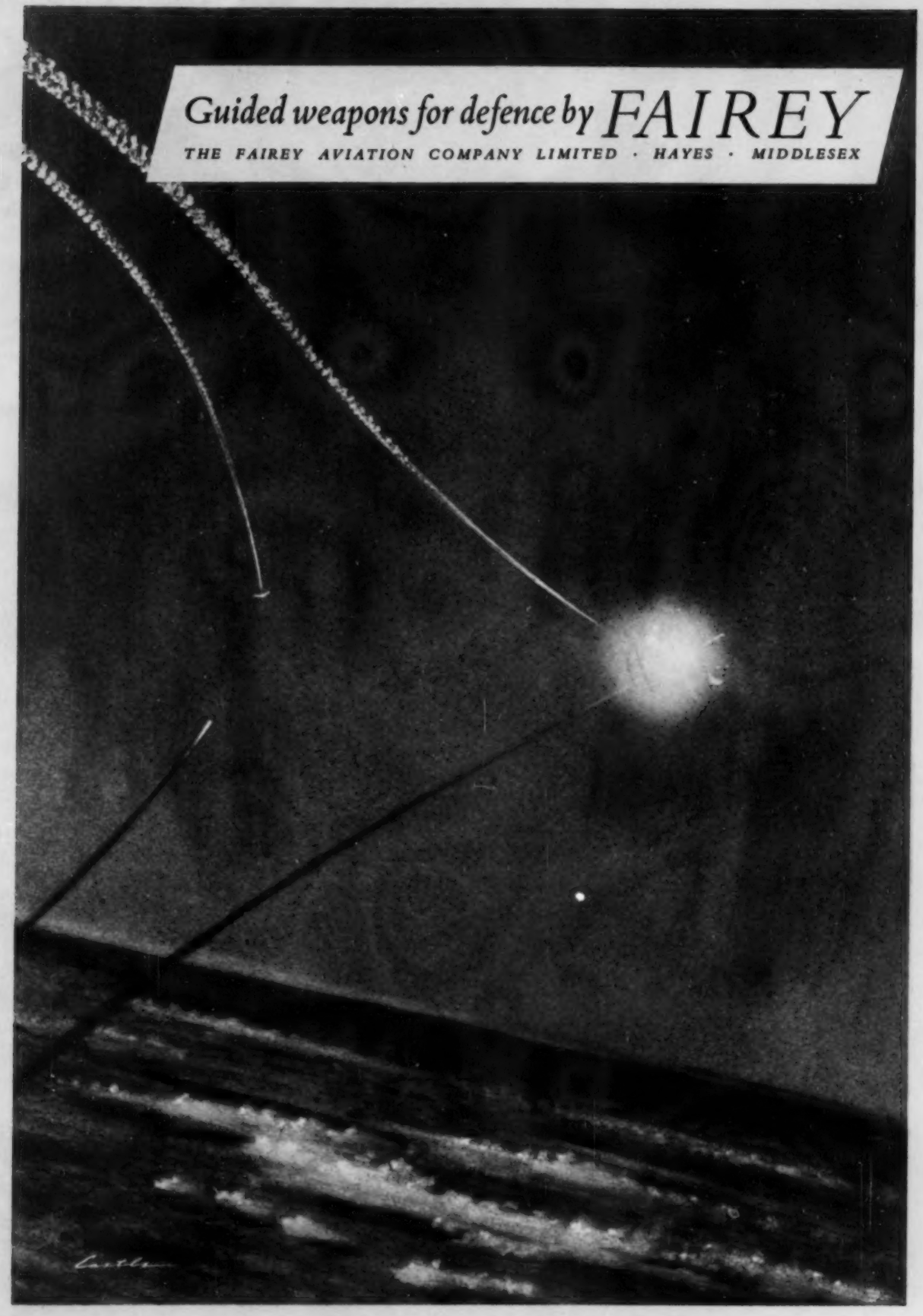
The next stage must be to examine whether such an aircraft would meet the needs of the private civil operators. These firms are the "tramp" owners of the air, and their business is to transport, at competitive rates, all types of freight and passengers between any two points in the world. One month they may be employed on troop-carrying between the U.K. and the Middle East; the next, they may be ferrying machinery to Africa, beef in Australia or race-horses in Europe.

To meet these conditions, the ideal charter operator's aircraft would seem to require the following characteristics:—

(a) Economy.
(b) Flexibility of operation over long and short stages.
(c) The ability to carry a wide range of loads.
(d) The ability to operate from a world-wide range of minor airfields.
(e) Robustness, simplicity and reliability with the minimum of maintenance in the field.

It is remarkable how closely these requirements conform with

(concluded on page 621)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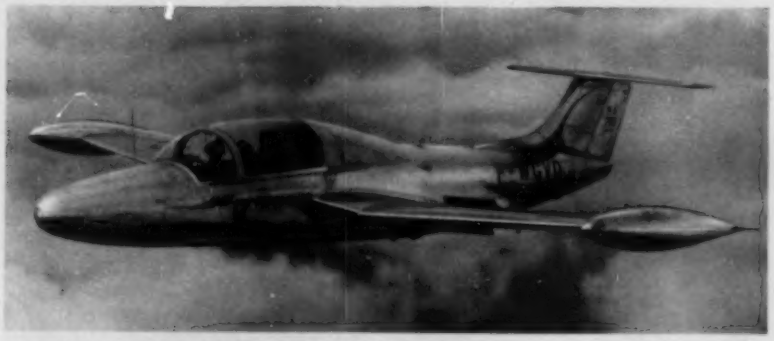
THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

UNDER INTENSIVE
DEVELOPMENT FOR
SUPERSONIC AIRCRAFT

GYRON

AIRCRAFT INTELLIGENCE



The Morane-Saulnier M.S.760 Paris (top) and Sipa 300, subjects of items on this page.

U.S.S.R.

*Modified I*1-12. A slightly modified version of the I1-12 twin-engined transport is now flying with V.I.P. transport units of the Soviet Air Fleet. It would appear that the only major difference is in the vertical tail assembly, which has a lower, more square-cut, top line. This reduction in area is somewhat surprising in view of the fact that the dorsal fin extension was added to the I1-12 some years ago. Members of Mr. Attlee's party flew in one of the modified I1-12s on their recent tour.

U.S.A.

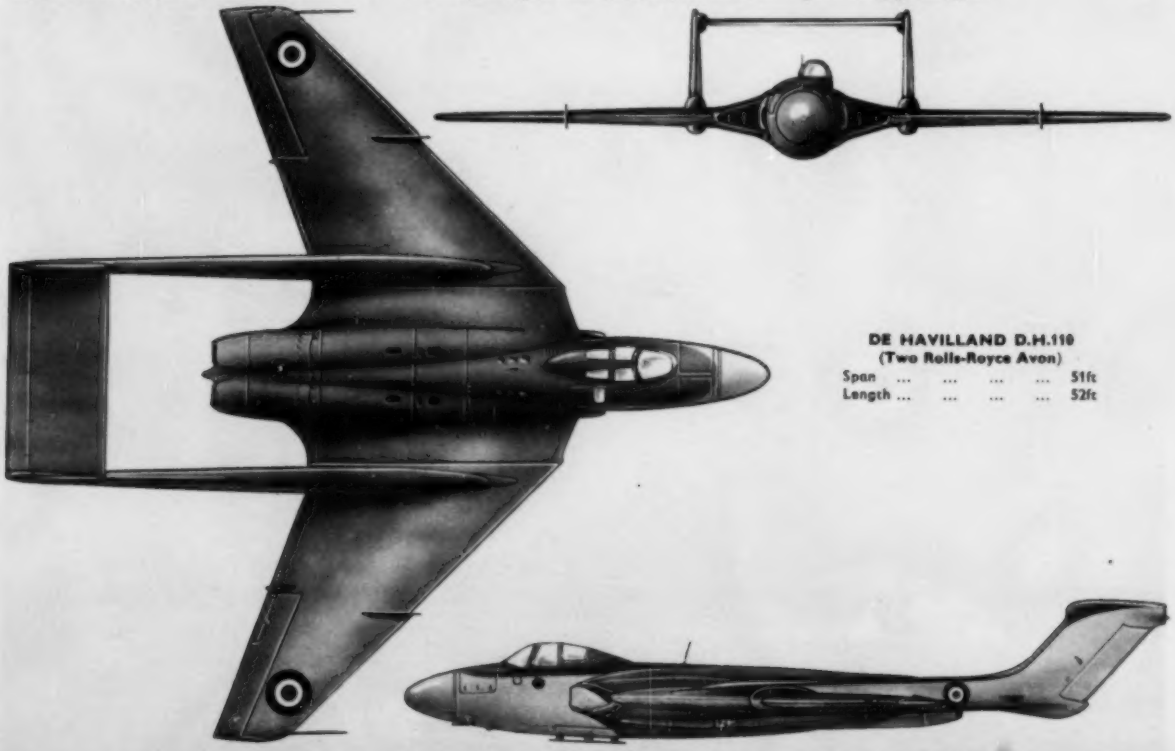
North American F-100 Development. Production of the present F-100A Super Sabre is now at almost its full rate, and a number of units will shortly be equipped with these first supersonic combat aircraft (the first is at George A.F.B., Victorville, Cal.). The F-100A is a day air-superiority fighter and intercepter, armed with four of the new M-39 20mm guns. The F-100B is a much-revised day-superiority variant, with a wing of the same sweep (45 deg) but only five per cent t/c ratio; it will have a nose rather like that of the F-86D, with an intake beneath a large radome, and a later version of the J57 will be fitted giving 15,000 lb rated thrust. The production F-100B will be styled F-107. The F-100C is an attack version with the original wing but with the later engine; at least 6,000 lb of stores will be provided for in underwing racks. The F-100D is another variant, probably with the new wing; it is the subject of a £35.7m order for the U.S.A.F. for aircraft to be built at Columbus, Ohio—a factory which has not previously built F-100s.

McDonnell F-101A Voodoo. Probably the largest single-seat fighter in the world, the long-range McDonnell F-101A Voodoo, powered with two Pratt and Whitney J57s, has made its first flight at Edwards Air Force Base, California. Photographs and particulars of this machine—as of the Lockheed F-104, which made its first flight many weeks ago—are withheld under the provisions of new American security regulations.

France

Sipa 300. This two-seat primary jet trainer, powered by a Turboméca Palas of 350 lb static thrust, made its first flight on October 4th. A tandem two-seater, it differs greatly from its predecessor, the Sipa 200 Minijet, which has flown more than 250 hr. The power-plant bay has been designed to take a unit of 660 lb thrust. Particulars are: span, 25ft; length, 21ft; height, 6ft; wing area, 105 sq ft; empty weight, 1,115 lb; gross weight, 1,800 lb; rate of climb, 890 ft/min; cruising speed, 205 m.p.h.; landing speed, 55 m.p.h.; ceiling, 16,500ft; range, 435 miles; fuel consumption at economical cruise, about 26 gal/hr. In the liaison rôle the Sipa 300 would fly at a gross weight of approximately 2,100 lb.

Morane-Saulnier M.S.760 Paris. Now officially named Paris, the M.S.760 four-seat jet-propelled liaison aircraft has lately undergone consumption tests at a height of 23,000ft and a speed of 340 m.p.h. These have shown that a safe range of 1,000 miles is attainable. The first flight was on July 29th, and by October 4th 52 hr 30 min flying had been logged by this promising prototype.



DE HAVILLAND D.H.110
(Two Rolls-Royce Avon)

Span	51ft
Length	52ft

WET WORK

Duties of the R.A.F. Marine Craft Training School

"FLIGHT" photographs

Three men in a boat (or perhaps Captain Bligh?): the airmen "ditched" for the demonstration manœuvre their craft.

THOUGH the R.A.F.—and, before that the R.N.A.S.—had used motor boats at their seaplane and flying-boat bases since the First World War, it was not until about 1935 that special-purpose marine craft came into service in considerable quantities. These were required initially to support Sunderland squadrons, and various types of boats were developed for servicing, refuelling and handling.

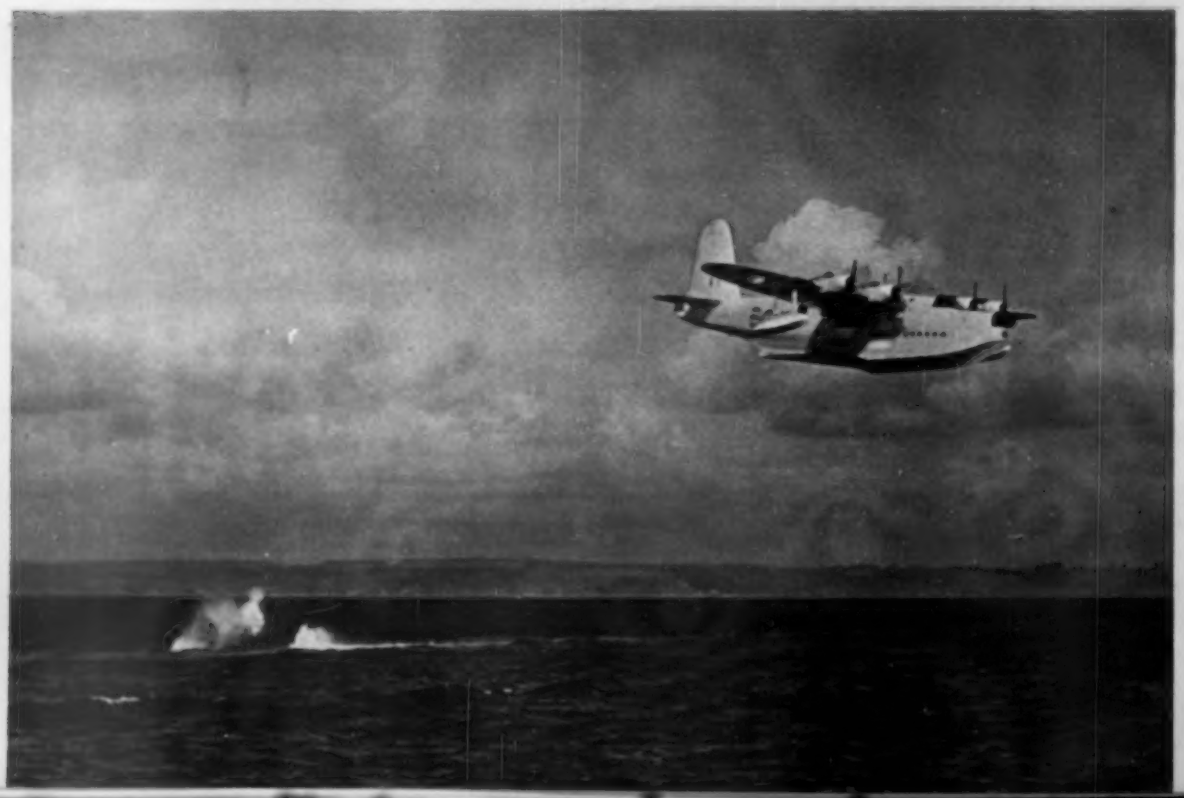
Since those days an organization has grown up which in 1948 was firmly established as the R.A.F. Marine Branch. During the war, craft capable of going to sea on rescue duties were brought into service, and in this primary rôle they saved no fewer than 13,269 lives, of whom 8,604 were aircrew. These sea-going boats were also used as training aids—as targets for interception by reconnaissance aircraft, and as target-towers for air-to-sea gunnery and bombing. Besides acting in these capacities, the marine craft have filled many rôles in war and peace; they were, for example, used in the evacuation from Greece and, more recently, in relief work following the Greek earthquakes.

During the war, R.A.F. marine units were stationed all over the world for search and rescue, and were equipped with 64-ft high-speed launches. In 1939, 11 were positioned around the United Kingdom coastline and one each at Malta, Aden, Basra and Singapore. In the following year, the Marine Craft Training School was founded at Calshot, on Southampton Water.

At first, officers for the boats were recruited from experienced men holding Board of Trade Master Mariners' Tickets. A number of these officers are still serving, but crews are now recruited entirely from within the Service, and trained at the school, which has since moved to R.A.F. Mount Batten, Plymouth. For operations in the Pacific, it was realized that a larger craft was required to cope with the longer ranges, but the 120-ft Fairmile launch, of which two squadrons actually set out for the Far East, never saw service because hostilities came to an end too early. At the end of the war the Marine Branch consisted of a 1,000 craft of all types, including 450 air/sea rescue craft, manned by 530 officers and 5,000 airmen boat crew. Today, search and rescue craft are based abroad at Singapore, Aden, the Canal Zone, Cyprus, Malta and Germany.

R.A.F. Mount Batten, commanded by W/C. W. H. Flint, houses the Marine Craft Training School (S/L. G. F. L. Coates), where crews are trained in both the operation and maintenance of marine craft. The duties performed are still much the same as they were during and before the war, but the 68-ft launches with Napier Sea Lion engines and a top speed of 25 kt, are now progressively being re-engined with three Rolls-Royce Griffons each, which will give an increase in speed of about 10 kt. A new 68-ft Vosper launch is now coming into service; it is a modified version of its predecessor, having 4ft greater beam, affording greater deck space, and an improved hull design which allows the boat to ride a rough sea more easily than before. Accommodation and equipment has been improved, and a full range of radar, D/F. and communications gear is installed. This to a large extent renders the boat independent of visibility and weather conditions when entering or leaving harbour. Launches are progressively being fitted with Sarah (Ultra search, rescue and homing) receivers.

A very near miss on a launch-towed splash target. The Sunderland which dropped the practice bomb is seen with bomb doors still open.



In the best nautical tradition, one of the latest Vosper 68-ft high-speed rescue launches keeps station, with flags flying, for this sea-to-sea photograph.

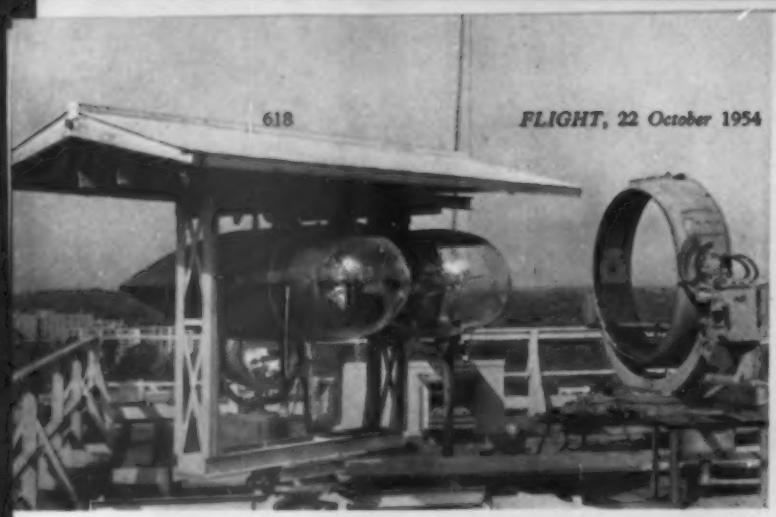
The new 68-footers can accommodate 97 people, including the captain and a crew of ten. In addition, they have a sick-bay in which it is possible to perform operations. Boat-crew airmen are volunteers, and service afloat is so popular that there is at present a waiting list.

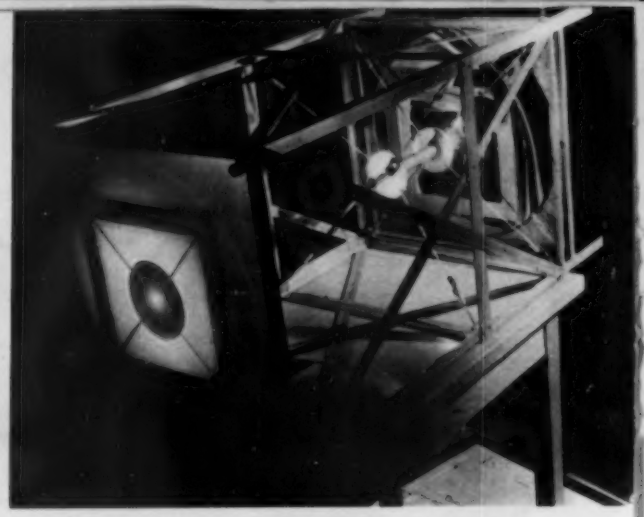
Launches are now stationed at 16 points in the British Isles, and their operations are controlled by two Rescue Co-ordination Centres, at Mount Batten and Dunfermline. As soon as distress messages or information about an accident are received, marine search and rescue operations are directed from these centres. The 68-ft launches are ready to leave harbour at 10 minutes' notice, and they can be supplemented by aircraft kept at constant readiness by all R.A.F. commands in the United Kingdom, by Fleet Air Arm aircraft, by Naval vessels, and by lifeboats and merchant ships. R.A.F. marine craft are also engaged on secret work at sea for the Ministry of Supply.

On October 11th, the work of these launches was demonstrated at Plymouth. A pair of the latest type sailed down Plymouth Sound, where a rescue demonstration was arranged. Three airmen were "ditched" in a dinghy and a Sunderland from Pembroke Dock dropped a set of Lindholme gear. This well-known war-time aid consists of a series of cylindrical containers linked by lengths of rope which are dropped in a long line down-wind of the dinghy. When the dinghy drifts down to them, the survivors can haul in the containers and make use of the wide variety of equipment provided.

After this had been done, Lindholme gear and "survivors" were taken aboard the launch, the latter with the aid of the scrambling net. The Sunderland next carried out a series of practice bombing attacks on a splash target towed by one of the launches. This was followed by a general demonstration of the speed and manœuvrability of the launches, during which the accompanying "sea-to-sea" photographs were obtained.

The "survivors" are helped up the scrambling net into the rescue launch (left) and (above) the Lindholme gear is retrieved.

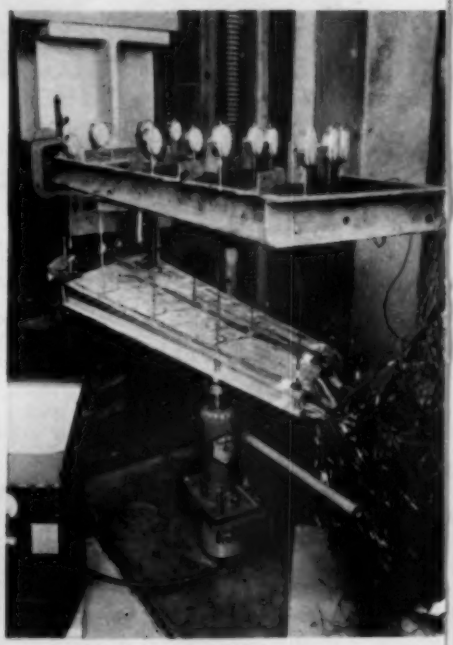




Airborne searchlights in a rotatable mounting on the laboratory roof for evaluation of various types of lamps and optical systems—an investigation for the U.S. Navy. (Right) Apparatus for determining efficiency of reflectors: a miniature lamp at the focal point of the reflector projects on to the screen a shadow of a circular mask, thus permitting reflector efficiency to be determined.

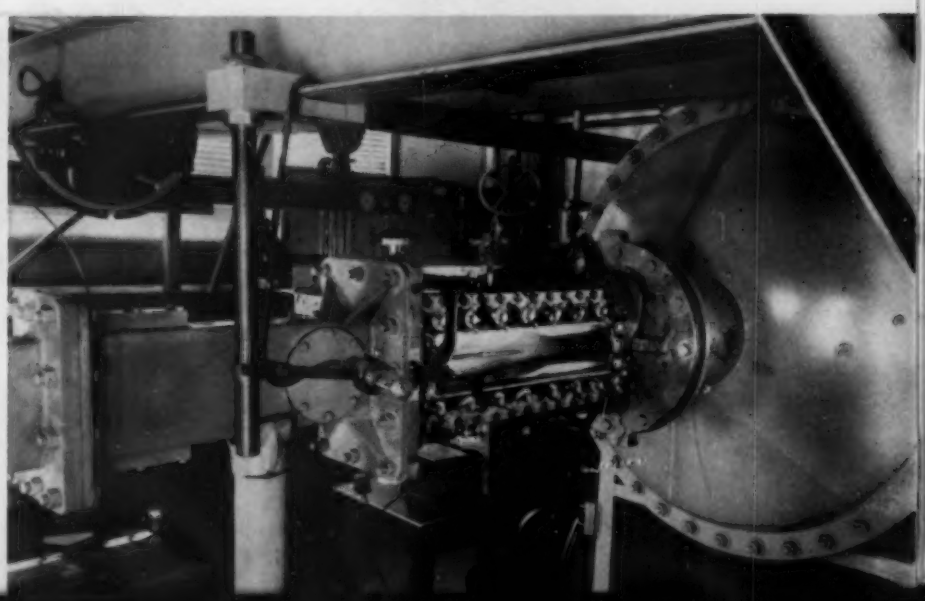
Research by the U.S. Bureau of Standards

THE work of the U.S. Bureau of Standards—a counterpart, in some degree, of our National Physical Laboratory and British Standards Institution—is broad in scope, covering the major fields in physics, mathematics, chemistry, metallurgy and various branches of engineering. With this background, the Bureau is frequently asked to undertake specific research and development projects for the Department of Defense, the Civil Aeronautics Administration, the National Advisory Committee for Aeronautics, the Navy Bureau of Aeronautics and the U.S.A.F. The Bureau, whose headquarters are in Washington, has been engaged on such work for many years: as long ago as 1929 it developed a radio-beam landing system, and it has investigated aircraft structures for more than 30 years. Whereas its earliest work in this field was on airship structures, today it is studying the problems of swept and delta wing configurations and such disconcerting modern phenomena as aerodynamic heating.



Applying a ceramic coating to a P. and W. J48 combustion chamber in preparation for a test of the ceramic material. (Right) Stress-distribution test on the inter-spar structure of a swept wing, by orthodox method with strain-gauges and dial gauges.

(Above) Air log developed by the Bureau for interference-free speed measurement in helicopter flight-testing. The rotor-driven sensing element is suspended by a cable from the aircraft. (Right) Working section of the Mach 2 wind tunnel.



Specially painted for Armstrong Siddeley, Roy Nockolds' abstract design portrays the tremendous power/speed potential of the Sapphire turbojet.

Chosen to power an impressive list of aircraft for the air forces of the N.A.T.O. powers — the Sapphire develops over 8,000 lb. thrust. With its small frontal area, resulting from an annular combustion chamber, the Sapphire blends well into the aerodynamic forms of supersonic aircraft.

★ ***THE SAPPHIRE*** *is being manufactured under licence by the Wright Aeronautical Division of the Curtiss-Wright Corporation in the U.S.A., where it is known as the Wright J-65.*

The Hawker
HUNTER *F.2 fighter*

The Gloster
JAVELIN *all-weather fighter*

★ *The Republic F.84F*
THUNDERSTREAK *fighter*

The Handley Page
VICTOR *crescent-wing bomber*

★ *The*
MARTIN B57 (*Canberra*) *bomber*

★ *The North American*
FURY *fighter*

★ *The Douglas A4D*
SKYHAWK *bomber*

ARMSTRONG SIDDELEY

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Members of the Hawker Siddeley Group

PIONEER DESIGNERS OF THE EJECTION SEAT

LOW EJECTION AT CHALGROVE

To determine a minimum altitude at which a safe ejection is practicable, with their latest Fully Automatic Ejection Seat, the Martin-Baker Aircraft Company conducted air tests at Chalgrove Airfield, Oxfordshire, on August 29th, 1954.

During the tests an ejection was made from a Meteor aircraft flying at 512 m.p.h. at the remarkably low height of fifty feet. The ejection was completely successful, the main parachute being fully deployed before the dummy alighted without injury.

This astonishing feat was made possible by the employment of two stabilising drogues in tandem, designed to reduce, with acceptable deceleration, the speed of the seat after ejection and then to control the main deployment of the parachute, thus eliminating the explosive opening characteristic. This seat was also fitted with the Martin-Baker Patent Barometrically Controlled Time Release Mechanism and Drogue Gun.

With this arrangement automatic separation from the seat after ejection occurs with insignificant loss of height, and safe escapes near the ground are made practicable. No other ejection seat is capable of this performance.

These design features are patented in the principal countries of the world.

MARTIN-BAKER

AIRCRAFT COMPANY LIMITED HIGHER DENHAM NEAR UXBRIDGE MIDDLESEX

COCKPIT AIR CONDITIONING

The Operation of Modern Systems for Interiors and for Suit-cooling

WITH current developments in aircraft design, the cabin air conditioning and pressurization system has really come into its own. For many years some form of cooling or heating has been provided; but often it has been regarded, particularly in military aircraft, as a somewhat doubtful luxury. Air supplied under pressure to a sealed cabin must be corrected for temperature, otherwise the crew are likely to suffer discomfort. In particular, when air in a cockpit is subjected to tropical radiation conditions it becomes intolerably hot. In such instances an air conditioning system is a necessity.

It is now customary to include air conditioning in the basic specification for new machines, and one of the principal companies engaged in the design and production of the necessary equipment is Sir George Godfrey and Partners, Ltd., of Hanworth, Middlesex. They have taken over the production of cabin superchargers originated by Marshalls, and for heat-exchangers they work in conjunction with Marston-Excelsior, but the design of complete systems and expansion turbine assemblies is their speciality. The expansion turbine is in fact the central unit in most of their products, and a description of the various types follows. The company's design, testing, development and pilot production is done at Hanworth, and series production takes place at another factory at Henley.

It is perhaps simplest in dealing with pressurization and air conditioning to begin by describing a Godfrey aircraft installation as illustrated in Fig. 1. Here it can be seen that the main source of charge air—that is, the "raw" air to be treated and delivered to the cabin—is a cabin supercharger. The charge air is taken from atmosphere by way of a filter and inward pressure-relief valve, and passed through a silencer to the pre-cooling stage. The pre-cooler consists of a Marston air-to-air heat-exchanger, so linked into the system that it can, if desired, be by-passed. This partly cooled charge air then passes into the ducting in the fuselage and through its final cooling stage, consisting of a "boot-strap" turbo-compressor cooling unit. (The term "boot-strap" was adopted because, in some respects, the system recalls the proverbial method of "lifting oneself by one's boot-straps.") This unit is described below; suffice it to say that it is the principal cooling unit in the circuit, and that it delivers low-temperature air *via* a water extractor direct to the cabin.

As in the case of the pre-cooler, this stage can also be by-passed so that hot air can be led direct into the cabin. In the arrangement shown in Fig. 1, there is a supercharger at each outboard engine feeding through its own pre-cooler to the cabin ducting. From the control panel in the cockpit, the various valves can be adjusted to select the pre-cooler and the cold-air unit, so that a great variety of air temperatures can be obtained in accordance with conditions prevailing. This conditioned air is continuously pumped into the cabin, and the actual cabin pressure is regulated at the outlet side by the cabin pressure control valve with, for safety reasons, a pressure-relief valve. A spill valve is provided between the supercharger and the pre-cooler, so that, if very little air is required, the supercharger delivery can be dumped overboard to relieve the system. Finally, a fan is incorporated in the cabin ducting to provide cooling air on the ground when the engines are not running.

In the case of aircraft powered by gas turbines, the Marshall supercharger is eliminated in favour of a direct compressor bleed. Here, of course, the first ram intake and the silencer are eliminated.

Godfrey systems working on this general principle are installed in a number of aircraft, including the Ambassador, Argonaut, North Star, Viscount, Vampire, Hermes, Britannia and Comets 1, 2 and 3; and other systems are, of course, being supplied for most of the latest high-speed military and research aircraft.

It must be realized, however, that although the performance and capacity of the individual units in the system may be perfectly well known, the efficiency of the installed system will depend mainly on the arrangement of ducting and inlets in relation to the volume of the cabin and the particular items to be cooled or heated. It is pointless, for instance, to inject a stream of cold or hot air into a cabin at a point whence its effect will simply not be felt. There have been many examples of inlet arrangements in cabins both small and large where the effect of the conditioning units has been entirely lost because the inlets were wrongly positioned or incorrectly shaped. Yet Godfreys point out that there is no fixed science in this aspect of the work. The company claims that the positioning of inlets is an art rather than a science, and especially so in the case of many military aircraft. It is the modifications which have been made in the field during trials that have made or marred systems. Generally speaking, however, it can be said that while a good heating system does not necessarily make a good cooling system, a good cooling system will, on the other hand, provide appropriate heating. Godfrey systems cater for both cooling and heating, and apart from the "hardware," the company supplies the know-how which will make a system work in its particular application.

Nowadays, the firm is often called in by a designer to produce the required air conditioning and pressurizing system while the aircraft is still in the design stage. Godfreys then require to know the heat load to be dissipated, and suggest the best layout. In many cases, the manufacturer himself will devise the general characteristics, and Godfreys then vet them. Size of ducting and the need for lagging, nozzle sizes and pre-cooler dimensions are established, and a complete replica of the system is assembled in the factory and tested. A company representative then attends during tropical trials so that any modifications which suggest themselves can be made on the spot if possible.

Often, experience dictates a modification which is comparatively simple, but whose effect is out of all proportion to the results produced. It must be remembered that, in many cases, aircraft weight and space limitations preclude the use of the most efficient system available, and in such cases the designers and Godfreys work out the best compromise.

The principal sources of heat from which the total heat load is calculated are as follows: the aircraft occupants (each body produces about 400 B.Th.U./hr), electrical equipment (particularly radar), skin friction and solar radiation. This last is quite important; the fitting of a clear hood to a single-seat aircraft can cause a temperature rise, due to radiation, of from 25 to 30 deg C.

The cockpits of military aircraft, either in hot weather or during

(1) Engine accessory drive shaft.
(2) Filter and inward-pressure relief valve.
(3) Cabin supercharger.
(4) Silencer.
(5) Spill valve and actuator.
(6) By-pass valve.
(7) Primary cooler (heat-exchanger).
(8) Venturi.
(9) Pressure differential switch.
(10 and 11) Non-return valves.
(12) Fan for ground cooling.
(13) Cabin pressure control valve.
(14) Cabin emergency pressure relief valve.
(15) Cold air unit by-pass valve.
(16) Choke valve.
(17) Recirculating fans.
(18) Control panel.
(19) Water extractor.
(20) Secondary cooler (heat-exchanger).
(21) "Boot-strap" turbo-compressor.

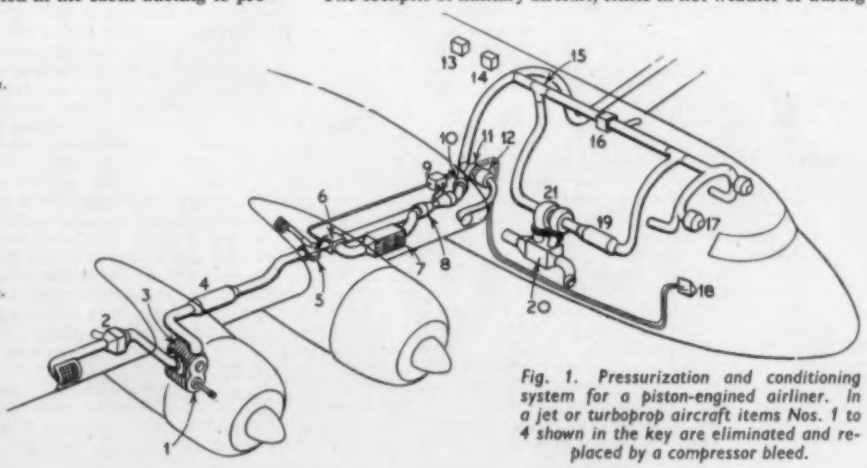


Fig. 1. Pressurization and conditioning system for a piston-engined airliner. In a jet or turboprop aircraft items Nos. 1 to 4 shown in the key are eliminated and replaced by a compressor bleed.

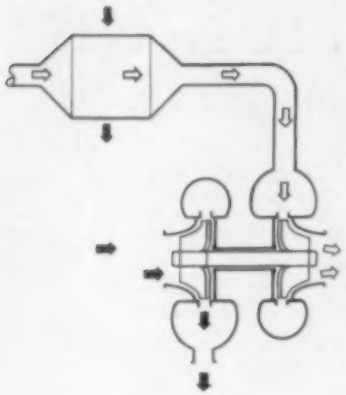


Fig. 2.

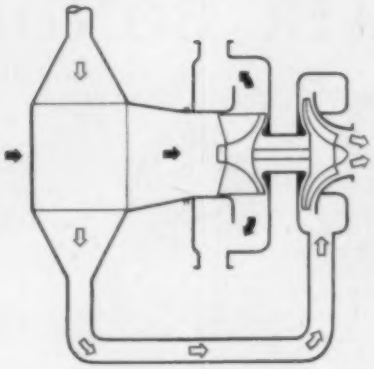


Fig. 3.

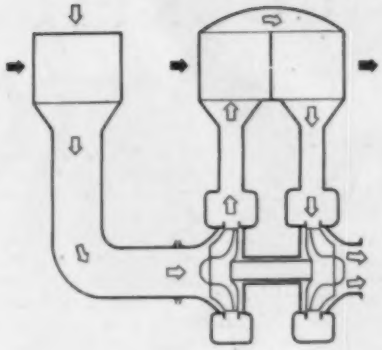


Fig. 4.

The three types of air turbine cooling unit, the brake turbine, turbo fan and turbo-compressor or "boot-strap." The black arrows show the airflow through the heat-exchanger and the white arrows the path of the charge air.

COCKPIT AIR CONDITIONING...

low-level operations, nowadays become unbearably hot unless some cooling system is fitted, and a great deal of work is being done by Godfreys on conditioning systems for both fighters and bombers. There are three basic arrangements, all relying on a combination of heat-exchanger and cold-air turbine unit to provide cooling and heating as well as pressurization. As in the civil system described above, cabin pressure is achieved by throttling the outlet from a sealed cabin by a barostatically controlled valve. But in any sealed cockpit there are numerous leaks, principally at the points where controls and cables pass through the pressure bulkhead; and, therefore, a continuous flow of air is required to maintain pressure. It is this flow which is temperature-controlled to produce the correct cabin temperature conditions.

The three basic systems are based on the brake turbine, the turbo-fan, and the turbo-compressor or "boot-strap" (Figs. 2, 3, 4). All three employ a radial inward-flow turbine which expands the airflow and thus cools it, but a simple expansion turbine is not efficient unless it is running under load, and therefore each is made to drive an outward-flow centrifugal compressor which provides this load. It can be seen that, in the three systems, this compressor is put to different uses: the main requirement is that the load from the compressor to the turbine should be constant. Various American designers have advocated that the expansion turbine should be used to drive an accessory such as a generator or an alternator; but such accessories produce a varying load, and therefore seriously, if not drastically, affect the performance of the expansion turbine.

There are particular qualities and characteristics of these three systems which can be described as follows:—

Brake Turbine.—In the brake-turbine system, the charge air (i.e., air derived from a supercharger or compressor bleed) passes first through a heat-exchanger and then through the expansion turbine. The drop in pressure results in a drop in temperature. The necessary load is provided by a compressor which simply takes air from atmosphere and then dumps it overboard again. In certain cases, of course, the compressor outlet can be made to drive a jet pump which will draw air through the heat-exchanger to provide a cooling flow while the aircraft is on the ground. This type of system is most useful where space and weight are limited.

Turbo-Fan.—This is generally similar to the brake turbine, but the fan which provides the load for the expansion turbine is large enough to pass the total cooling flow required through the heat-exchanger. The unit is generally more bulky than the brake turbine, but it does produce efficient cooling while the aircraft is on the ground. Two Godfrey T.F.10 units working on this principle and producing 75 lb of air per minute are installed in the Britannia and the Comet 3.

Turbo-Compressor.—In this system, often known as the "boot-strap," the charge air passes through both the compressor and the expansion turbine, but a heat-exchanger is interposed between these two units so that the compressor is situated upstream of the heat-exchanger. The temperature level of the air entering the turbine is too low to permit heat dissipation by direct surface heat exchange. Heat energy is extracted from the ventilating air by the turbine and converted into mechanical energy. The energy is then transmitted to the compressor by the common shaft, where it is returned as heat to the airstream at the heat exchanger inlet at a temperature where direct heat exchange is possible. All the heat lost is dissipated in the heat-exchanger. The advantage of this system is that it can be used where the charge air is supplied at low pressure. As shown in the "boot-strap" diagram, a pre-cooler (heat-exchanger) is placed upstream of the compressor. In some systems, this pre-cooler is eliminated. It is possible to take the cooling air (generally derived from a ram air intake) through both heat-exchangers, or to make use of two intakes, one for each unit.

The three cold-air units described above constitute the basic component of a system, and there are a number of other items which are normally included in a complete system, one of which is the water extractor. When running on a test rig the expansion turbine produces a jet of extremely moist air, and sometimes a plume of vapour. Therefore, most systems incorporate a water extractor. This is a small unit which, containing no moving parts, simply extracts water from the air in much the same way as a heat-exchanger extracts heat from it.

In every system, furthermore, there must be some means of by-passing the various cooling stages, so that the hot air bled from the compressor can be passed direct to the cabin for heating. For this purpose, a series of three-way valves and by-pass ducts is incorporated and so arranged that the pilot (in military aircraft) can select "cold," "warm" or "hot."

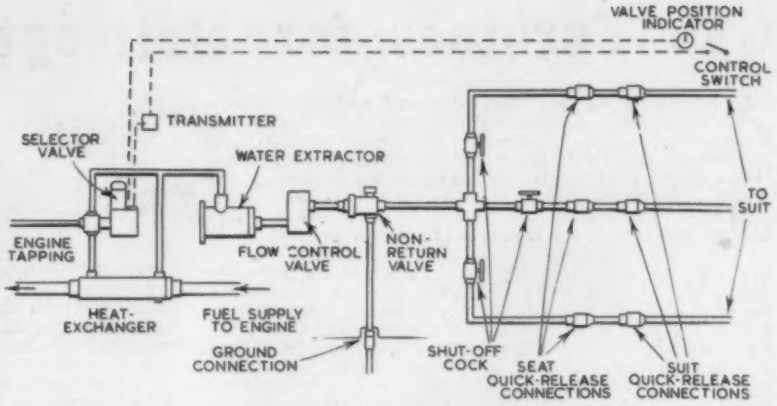
Security restrictions make it impossible to go into greater detail about these systems as applied to particular aircraft. Suffice it to say that the individual components, the turbines and heat-exchangers, valves and ducting, are surprisingly small. The components themselves can, moreover, be distributed in the aircraft even despite the usual space limitations. Few of the turbine units are even as much as a foot in diameter, and they work at approximately 55,000 r.p.m. Their lubricating systems are integral and independent.

The Air-Ventilated Suit.—There are, of course, two approaches to the problem of air conditioning in military aircraft. One can either cool the whole crew compartment when climatic or other conditions demand it, or one can leave the equipment to stew and simply cool the bodies of the crew. For some time now, the air-ventilated suit has been worn by crews of such aircraft as the Canberra and Wyvern where cockpit temperatures in low-level flight or in the tropics on the ground reach an intolerable level. The suit itself was designed by the Institute of Aviation Medicine at Farnborough and produced by the G.Q. Parachute Co., Ltd., but the air-supply system is a Godfrey development.

It may be remembered that the suit is made of light nylon fabric, with some 90 to 100 vein-like air tubes sewn into it and arranged to distribute cool, dry air to all the required parts of the body. More particularly, a dry air-flow of 8 cu ft/min at 7.5 lb/sq in at a temperature of between 70 and 110 deg F is needed to provide cooling by evaporation of perspiration. The first version of the suit did not cover the lower legs and feet, the forearms and hands, or the head; but the latest version, shown at Farnborough this year, extends to the ankles and wrists and allows a special cooling helmet to be plugged in.

The diagram (Fig. 5) shows the air-supply system developed by Godfreys for the Canberra's ventilated suits. Three men must be cooled, and therefore 24 cu ft per minute of air are needed, but no large moving parts requiring power drive can be used. It was accordingly decided to utilize the heat-absorption capacity of the aircraft fuel for cooling. A small and simple heat-exchanger

Fig. 5. The system which supplies cool, dry air for the three ventilated suits worn in Canberras, showing compressor bleed charge air, fuel heat-sink and water extractor.



is attached to the main fuel supply line to form a heat-sink. An engine compressor bleed is then arranged to pass air through the heat-exchanger, through a water extractor, and thence *via* a flow control valve to the suits. A selector valve controlled from the cockpit allows the pilot to select full cooling through the heat-exchanger, partial by-pass or full by-pass as required, and an individual tap is provided for each crew-member. A ground connection is incorporated so that, while the crew are waiting in the aircraft on the ground, cool dry air can be pumped direct to the suits from a special ground trolley.

Many aircraft—and here we include military as well as civil machines—require some form of ground cooling for the occupants before the engines are started. One of the most efficient means of supplying this cooling is by a special ground trolley. Godfreys make a variety of ground air conditioning trolleys for military and civil applications, using the expansion-turbine technique.

Finally, guided missiles, containing as they do a great quantity of electronic equipment, require extremely small, compact systems in flight and further systems while waiting to be launched. It is obviously not possible to detail any of these, but developments in this direction will be watched with great interest.

C.M.L.

MOBILITY IN READINESS (continued from page 614).

those of the military operator. In the civil field there is greater emphasis on economy, but this will derive largely from simplicity, robustness and low capital cost. The military demands for rear-loading and multiple parachute exits find no directly equivalent bid from the civil operator, but these features will certainly not prove objectionable to operators required to load bulky items of machinery or cars, and to carry high-density passenger loads.

Here then is a type of aircraft that should suit both the military requirement and the civil operator. Incidentally, it should not be difficult to produce variations on the original theme to meet the specific needs of different charter firms without departing from the basic military requirements. If these aircraft are to form our reserve transport fleet, the private operators must be persuaded to equip with them in peace. This, it is suggested, should be achieved by means of a useful Government subsidy, at least towards capital cost. Here there is a direct analogy with the Naval subsidized requirements in merchant ships.

A brief examination of the benefits afforded by such a scheme is illuminating. The Government is provided with a reserve transport aircraft fleet at a cost which is a fraction of that involved in ordering new aircraft and providing crews and ground staff. The Army is assured of the existence of a fleet of transport aircraft suitable for its needs and available at short notice in peace as well as war. The R.A.F. can see this pressing commitment met without the need to divert any financial or manpower resources from their immediate tasks. Finally, the independent operators are enabled to re-equip with modern, highly suitable aircraft on extremely favourable terms.

To these outstanding advantages can be added subsidiary benefits. First, the crews and ground-staff of the charter operators can provide the necessary manpower without the need for special provision from elsewhere. Ideally, a form of special Air Transport Reserve should be created to allow crews and staff to come under service direction in an emergency. Secondly, by re-equipping private firms with standard types of aircraft, the problem of spares and maintenance in an emergency is enormously simplified. Thirdly, substantial orders for this type of aircraft in peace and their subsequent development and replacement, would provide invaluable manufacturing capacity for rapid expansion in war, when very much greater quantities of such aircraft will be urgently required. Finally, throughout this article the main stress has been on the Army's need for transport aircraft, for this is the most pressing demand. Nevertheless, it will be evident that such a pool of air transport would be of inestimable value to the other two Services, and to all Government departments.

There is the plan. Some may say that we cannot afford it. Rather, in view of the vital necessity of providing suitable air transport capacity in war, can we afford not to adopt it?

SUPERSONIC SQUADRONS FORMING

NORTH American Aviation, Inc., are a comparatively young company, for they only began to build aircraft in the middle 1930s. Since that time, however, they have made more aircraft than anybody else (the 50,000th was built early this year). Another telling demonstration of their ability is provided by the fact that the mighty F-100 Super Sabre, the world's first supersonic combat aircraft, has been flown, tested at subsonic and supersonic speeds, fully proven as a combat weapon, and put into production and delivered in quantity to the U.S. Air Force all in the space of 18 months. The photograph shows some of the first F-100As for the Tactical Air Command being collected at the company's Los Angeles plant from J. S. Smithson, vice-president (manufacturing). The first machine was accepted by Lt. Col. Maurice G. Long, commanding the 436th Squadron; he was accompanied by Col. Jacob W. Dixon, 479th Group commander and Lt. Col. William B. Harris, commanding 434 Squadron. Their base is George A.F.B., Victorville, California. Note the supersonic combat drop-tanks and the blast-tubes for the four M-39 cannon.

Gas Turbines for Helicopters

Mr. John Brown, M.A., whose lecture to the Helicopter Association is summarized here, is a senior scientist at the National Gas Turbine Establishment.

AT the second meeting of the Helicopter Association's 1954-55 lecture programme, held in the library of the Royal Aeronautical Society on October 15th, a paper entitled *Some Applications of Gas Turbines to Helicopter Propulsion** was presented by Mr. John Brown, M.A. Introducing the lecturer, the chairman, Dr. G. S. Hislop, said that Mr. Brown was a senior scientist at the National Gas Turbine Establishment at Farnborough and one of the leading authorities in the country on the subject of his lecture.

Mr. Brown began by saying that the scope of the paper was limited to the application of gas turbines to helicopters in which the rotor was used to provide the total propulsive thrust in addition to the lift. It did not cover the wider field in which lift and propulsive power were obtained from a combination of fixed and rotating wing surfaces and orthodox airscrews. Among the advantages accruing from the use of gas turbines, low weight-to-power ratio, little vibration, low frontal area and the ability to use fuels other than petrol were the most important. Against these had to be set increased fuel consumption and the possibility of installation difficulties. Installation might be a problem owing to the extra length of the engine and the size of the gearbox required in the direct drive scheme.

He then went on to describe three main schemes for engine-rotor systems, the shaft drive, the ducted gas and the ducted air schemes, each of which had in common a basic gas turbine unit comprising a compressor, combustion chamber and turbine. The first scheme, the shaft drive, simply entailed the addition to the basic unit of a free power turbine, placed in series with, and downstream of, the compressor turbine. The free turbine shaft was then used to drive the main rotor shaft through suitable reduction gearing. Alternatively, the power turbine could be coupled directly to the turbine driving the compressor, this being known as the fixed shaft turbine. Here, however, there was no particular advantage as regards engine performance; in fact, for the low power settings the reverse was true. The fixed-shaft turbine also required that the rotor drive should be separated from the turbine drive shaft by means of a clutch mechanism, which was unnecessary in the free turbine. Almost all arguments were in favour of the free turbine for the shaft drive application.

In the second application, the ducted-gas scheme, the turbine in the basic unit was used to drive an auxiliary compressor in addition to its own compressor. Air drawn in and compressed by the auxiliary compressor mixed with the turbine efflux at a common static pressure in the collector and was ducted through the blades to provide reaction propulsion at the tips.

The third method, known as the ducted-air scheme, was similar to the second application in that reaction propulsion at the blade tips was used to drive the rotor. The difference between the ducted-gas and ducted-air schemes lay in the fact that it was only the air from the auxiliary compressor which was ducted through to the blade tips where, by introducing a separate fuel supply, blade-tip burning could be added to increase the rotor driving power.

In addition to the three main schemes, there was another way in which the gas turbine could be used to drive the rotor and that was to mount a complete unit at the tip of each blade. There were three possible installation positions; firstly, across the blade, the engine being in a line tangential to the rotor-tip path; secondly, radially along the blade with the air intake at an inner radius and the exhaust jet at the tip; or thirdly, radially along the blade with the air intake at the tip and the jet at an inner radius.

Of the two last-mentioned alternatives, the lecturer said that calculations taking into account the centrifugal effects on the air in its passage along the length of the engine showed conclusively that the installation having its intake at the inner radius was superior. However, all three alternatives for tip-mounted engines presented the designer with serious mechanical problems.

Mr. Brown continued with a discussion of performance estimates for the three main schemes. His calculations showed that the thermodynamic design performance of the ducted-air scheme was inferior to that of the ducted-gas scheme which, in turn, was inferior to that of the shaft-drive application. These calculations had been taken in conjunction with engine weight estimates and specific fuel consumption for the three main schemes to form the conclusions of his investigation.

For the purpose of arriving at engine weight estimates, a helicopter of 10,000 lb a.u.w. had been chosen, powered by two engines of the three main types described. A rotor-tip Mach number of 0.5 was used in each case. Due weight allowance had been made for additional turbine stages, and for the number of stages required in schemes employing auxiliary compressors. On this basis, the weight of the pair of engines was estimated as:—

Shaft-drive scheme: Engine weight, 820 lb; tail-rotor gearing and transmission, 900 lb; total, 1,720 lb.
Ducted-gas scheme: Engine weight, 1,300 lb.
Ducted-air scheme: Engine weight, 2,340 lb.

In the ducted-air scheme, rotor drive power could be increased by burning additional fuel in combustion chambers at the blade tips and, taking this into account, engine weight estimates for this scheme were considerably reduced. A maximum gas temperature of 1,500° K (2,240° F) had been selected for the rotor nozzles as being reasonable from the metallurgical point of view, but figures were also presented for a temperature of 1,000° K. The corresponding engine weights were 840 and 1,170 lb.

In fairness to the shaft-drive scheme, the lecturer pointed out that a saving in weight of some 200 lb was estimated for other parts of the helicopter.

Overall results of the calculations showed that, for low endurance, the ducted-air scheme with burning at the rotor tips was the best, because of its low engine weight—which possibly pointed to a conclusion that this type of drive might be advantageous for take-off purposes, provided that some additional method of forward propulsion could be used in the machine. (As had been previously stated, the figures quoted referred only to helicopters in which the rotor provided the total propulsive thrust in addition to the lift.) For endurances of, say, one hour's cruising with ten minutes' hovering, the order of preference would be shaft drive, ducted gas, and then ducted air, with or without blade-tip burning.

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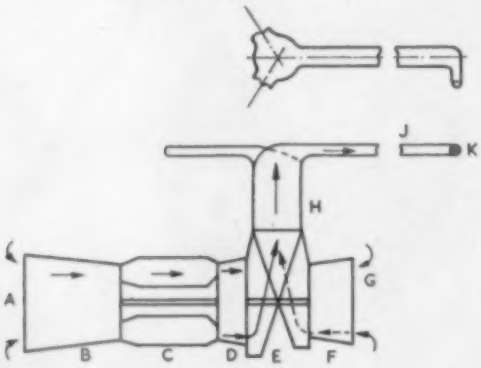
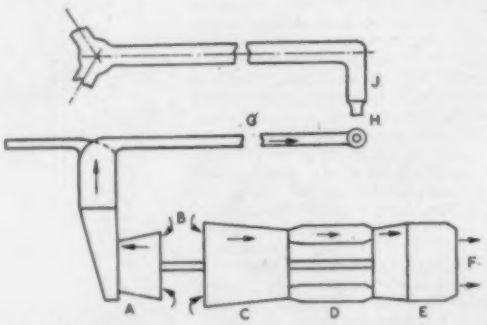


A Air intake
B Main compressor
C Combustion system
D Turbine
E Volutes
F Auxiliary compressor
G Air intake
H Collector
J Rotor
K Nozzle

Diagrammatic arrangement of main units in the ducted-gas scheme.



A Auxiliary compressor
B Air intake
C Main compressor
D Combustion system
E Turbine
F Low-velocity exhaust
G Rotor
H Nozzle
J Combustion chamber

Arrangement of ducted-air scheme with burning at rotor tips.

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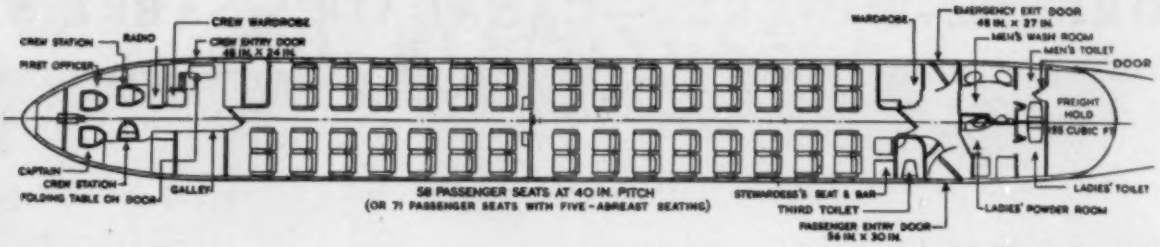


Interior layout of the Comet 3 (first-class).

COMET FURNISHINGS

Comet 2 and 3: library and drinking-water fountain.

Comet 2 and 3: D.H. double chair (left) and bar.

INTERIOR features of the latest Comets, as styled for B.O.A.C., are shown in these new illustrations. At the head of the page is a cabin plan of the Comet 3, in 58-seat first-class form; tourist versions can carry up to 78. No tourist scheme has been put forward for the Comet 2, which has a standard seating layout for 44 passengers.

Both types of Comet have a bulkhead separating the cabin into two compartments and thus avoiding "tube effect." The great length of the Series 3's cabin makes this division particularly desirable. Another advantage of the bulkhead, in the case of the Comet 3, is the ability to operate it as a two-class aircraft; seating capacities of the two compartments are 26-34 (front) and 32-42 (rear).

Accommodation in B.O.A.C.'s Comet 1s was for 36 passengers, of whom eight travelled in four pairs of facing chairs in a separate forward compartment. This eight-seat forward cabin is retained in the 44-seat Comet 2, but the first four seats are no longer rearward-facing and are now fully reclining.

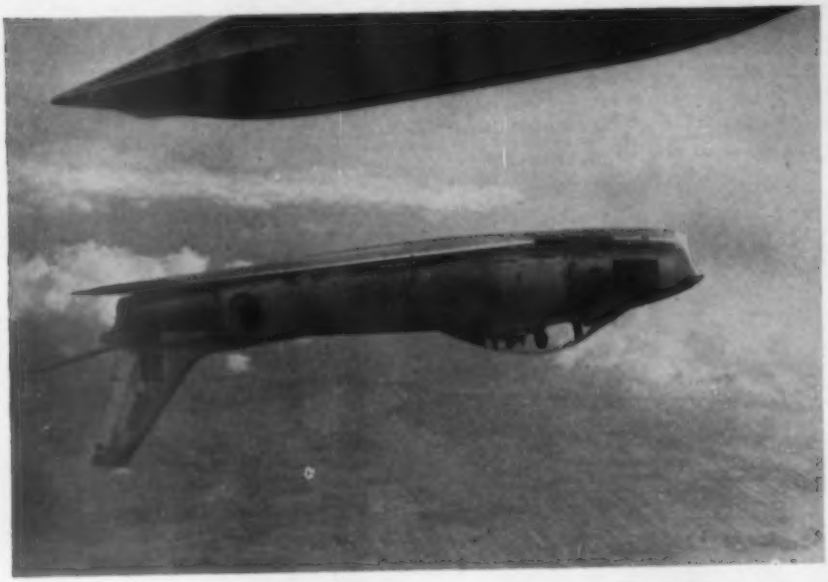
The Comets 2 and 3 are the first aircraft to employ the new de Havilland double chair, which effects a considerable weight saving—it weighs only 50 lb—but continues to offer first-class comfort. Each half of the seat is individually adjustable through a reclining angle of 26½ deg, and, as illustrated above, a leg-rest attachment can be fitted for night travel. The structure of the chair and its seat-belts are stressed to 9g forward.

In many respects, the interior styling of the Comet 1—described by *Flight* in 1951 as "a perfect complement to the beauty of the machine"—has been retained in the new versions. Seats are dark blue, with crisp white headrest covers; ceiling and walls are grey; and a touch of brightness is provided by the light-red-and-white striped curtains. Like their predecessor, the Series 2 and 3 have all the usual "offices"—powder rooms, toilets, vestibules and library—at the rear end of the cabin, and an additional feature of the later machines is a bar, as illustrated above.

Particularly when it is borne in mind that no Comet will normally be required to operate stages taking longer than about five hours—usually considerably less—the "passenger amenity" space is generous in both the series 2 and 3; for example, the washrooms, wardrobe and similar installations in the Comet 3 occupy some 12 feet of fuselage at full cross-section. One point worth noting is that the Comet 3 has an additional emergency exit door on the starboard side of the fuselage opposite the passenger entrance. The great length of the series 3 fuselage (111ft) has also made available a considerable increase in freight and baggage volume. In the Comet 2, there is a 185 cu ft underfloor hold behind the wing, supplemented by two holds forward above the floor totalling an additional 246 cu ft; in the series 3, however, there is a 150 cu ft hold under the forward floor, a 240 cu ft hold under the rear floor, and a 155 cu ft hold at the extreme end of the pressure hull which can be reached from inside the cabin and loaded *via* a separate door on the starboard side of the aircraft.

Comparative views of the interiors of the Comet 3 (left) and Comet 2. The latter is shown looking aft from the eight-seat forward compartment; the Comet 3 interior shows the two large cabins arranged for 58 first-class passengers.

ORENDA-POWERED—CANADAIR'S SABRE 5



These spirited impressions of the Canadair-built Sabre 5, powered with an Avro Canada Orenda turbojet and having the so-called "slick" wing (i.e., with the 6/3 leading edge in place of the former slats), were secured by Mr. Hugh MacKechnie, using a Speed Graphic camera rebuilt according to his own ideas.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

A Gnat-equipped V.R.?

WE know now that Britain is to station an entire Tactical Air Force on the Continent for the next forty-four years. We also know that for some considerable time both sides of the House have been agitating for a reduction in the period of National Service. It follows, therefore, that an immediate and drastic reorganization of home-based units is necessary if an attempt is to be made at solving the problems of manpower; and there can be no doubt that a solution to this impending problem must be found quickly.

The logical answer would seem to be the supplementing of regular home units by a substantial operational reserve. Hitherto the objections to the Volunteer Reserve have been that flying does not reach operational standard and that the upkeep of a really useful reserve force is too expensive.

Our European commitments have brought about the urgent need for a strong reserve Air Force, and the advent of the Folland Midge has created new possibilities for the formation of an indispensable second-line defence.

Can anyone who witnessed the performance of the "little fighter" at Farnborough doubt that the more powerful Gnat will prove a worthy supporter to the heavier, faster and more costly types, provided it is used in sufficient numbers? A large force of these aircraft can be produced at approximately one-third of the cost of the larger fighter. Operation and maintenance are said to be much easier.

The Volunteer Reserve could be selectively reconstituted on lines similar to the R.Aux. A.F. with pilots and ground crews trained to modern operational standards on these efficient and comparatively inexpensive aircraft.

A sudden emergency would find our present reserve of twenty Auxiliary squadrons pitifully weak. Let's face the fact that we managed to survive the last onslaught because, among other things, our adversary blundered on more than one major occasion and also failed to follow up the advantages gained early in the war. Our future enemy might not be so obliging.

Germany is planning a new Luftwaffe whilst the Japanese are already taking delivery of Sabres and other modern American equipment. The time is ripe for another change of policy, a change that will strengthen our defences and reward the foresight and enterprise of those responsible for the production of the Midge.

Eastcote, Middx. BERNARD A. SPARROW.

Beginning of the A. and A.E.E.

IN your issue of September 10th, I note that in the article on the A. and A.E.E., Boscombe Down there is a statement to the effect that the unit was formed from a squadron which returned from France in 1917. This is not quite correct, although personnel from overseas were drafted to Martlesham from time to time. There was no great alteration of personnel whilst I was with them from 1917 to 1920.

The unit was originally formed up from officers and mechanics of the Central Flying School in 1916, and was known as Testing Squadron, R.F.C. A move was made to Martlesham in early 1917, I believe, and R.N.A.S. personnel were then included in its make-up.

A squadron was moved temporarily from France in 1917, and 66 Squadron, 9th Wing, R.F.C., flew from Estrée Blanche to Hornchurch for the defence of London, after the big daylight raid on the City. They remained at Hornchurch for about a fortnight. In actual fact it was a de Havilland 4 flown by Capt. Palethorpe, M.C., with 1st A.M. Jessop, of the Testing Squadron, who, at the termination of a test flight, found themselves in the middle of an enemy squadron, and promptly had a "go."

The gallant captain was wounded; and Jessop, after getting off about four drums of Lewis ammunition, was mortally wounded.

The unit was renamed Aeroplane Experimental Station about the end of 1917, and, on the decease of the Armament Experimental Station, Orfordness, when duties were combined, became A. and A.E.E. Martlesham Heath in 1918, where it remained until shortly before the beginning of the last war.

Tripoli, Lebanon. A. L. EGGLETON.

Three-owner Constellations

I WAS very interested in the article in *Flight* of October 1st, concerning the Constellation 4X-AKD. It may be of interest to readers to know that there are at present three Constellation aircraft operated by B.O.A.C. which have also served three airlines. These are: G-AMUP *Boston*, G-AMUR *Barnstaple*, and G-ANTF.

G-AMUP and G-AMUR were originally owned by American Overseas Airlines, and were registered N90921 *Flagship London* and N90927 *Flagship Glasgow* respectively. When American Overseas Airlines was taken over by Pan American World Airways, these aircraft were renamed *Clipper Jupiter Rex* and *Clipper Wings of the Morning*. They remained as such, until P.A.A. sold them to B.O.A.C. in 1953.

G-ANTF was originally UT-CQR, of Air India International. It was sold to Qantas Empire Airways, who named it *Horace Brinsmead*, registration UH-EAF. It was sold to B.O.A.C. in July of this year, and has yet to be renamed.

Watford, Herts. J. W. TAYLOR.

THE story of the El Al's Lockheed Constellation 4X-AKD, appearing in the October 1st issue (page 522), proved most interesting. We would like to point out, however, that the task of making the erstwhile G-AHEN airworthy to U.S. Civil Aeronautic Administration standards was performed by Lockheed Aircraft Service-International, at New York International Airport, Idlewild.

In what up to that time had been the most extensive rehabilitation project undertaken by a commercial aircraft maintenance and service organization in the U.S., LASI delivered the plane to its owners in the spring of 1952 with zero time on both the aircraft and engines, 29 weeks after the damaged hull and other components were unloaded at a New York City dock.

Incidentally, it might be of interest to you to know that each issue of *Flight* is eagerly read in this office for authoritative information in world-wide aviation. You are to be congratulated upon the excellent service you render the many elements of this industry. MEL ADAMS AND ASSOCIATES, INC.,

New York Charles E. McGee, Vice-President.

FORTHCOMING EVENTS

Oct. 25. University of Liverpool Engineering Society: Survey of Helicopters, by S/L. A. Armitage.
Oct. 25. Women's Engineering Society: "The Metal Spraying Process," by J. A. Shepherd.
Oct. 26. Institute of Transport: Visual aids meeting: films on air transport.
Oct. 27. R.A.F. College, Cranwell: Rugby v. Oxford University Greyhounds.
Oct. 27. Institute of Welding: Annual dinner.
Oct. 27. British Institution of Radio Engineers: Annual general meeting, and presidential address by Rear Admiral Sir Philip Clarke, K.B.E., C.B., D.S.O.
Oct. 28-29. Institute of Welding: Presidential address by Mr. R. G. Braithwaite, M.I.C.E., and discussions on papers dealing with welding and materials.
Oct. 29. R.Ae.S. Graduates' and Students' Section: Reception and dance.
Oct. 30. S.L.A.E.: "Developments in Aircraft Pressurization," by F. W. Michael.
Nov. 2. R.Ae.S. Section Lecture: "Design of Small Jet Engines," by H. S. Rainbow.
Nov. 4. R.Ae.S. Main Lecture: First Sir George Cayley Memorial Lecture, by Capt. J. L. Pritchard, C.B.E. (at Hull).
Nov. 4. R.Ae.S. Graduates' and Students' Section: Film—"The German A.4 Rocket (Operation Backfire)."
Nov. 4. Institute of Metals: "Trends in Metallurgy," by Prof. A. G. Quarrell, Ph.D., D.Sc.
Nov. 10. Institute of Transport: Anniversary luncheon.
Nov. 11. R.Ae.S. Main Lecture: "Boundary Layer Control," by Dr. G. V. Lachmann., F.R.Ae.S.
Nov. 12. Helicopter Association: "Helicopter Production," by E. J. Boulger.
Nov. 13. R.A.F. College, Cranwell: Soccer v. R.M.A., Sandhurst.
Nov. 16. R.Ae.S. Section Lecture: "Uses of the 'Ace' Computor," by Dr. E. T. Goodwin.

R.Ae.S. Branch Fixtures (to Nov. 9): Oct. 25, *Halton*, "Helicopters," by Sgt. App. J. Harrod; *Henlow*, "The Case for the Light Fighter," by P. A. Norman. Oct. 26, *Boscombe Down*, "Space Flight," by J. Humphries. Oct. 27, *Halton*, visit to College of Aeronautics.

Nov. 2, *Glasgow*, "Transonic Flight," by M. J. Lithgow. Nov. 3, *Luton*, film and discussion evening. Nov. 4 *Brough*, Main Lecture (see above); *I.O.W.*, annual dinner.

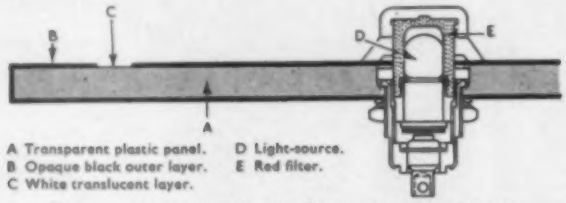
Nov. 8, *Henlow*, "Schneider Trophy Races and Their Influence on Aircraft Design," by G/C. L. S. Snaith. Nov. 9, *Belfast*, "New Materials for Aircraft Construction," by G. O. Jones.

THE INDUSTRY

ILLUSTRATED here in diagrammatic form is the principle of the Thorn "Plasteck" instrument panel illumination system which, exhibited by the Aircraft Components Division of Thorn Electrical Industries, Ltd., caused considerable interest at the recent Farnborough Show. The method provides for illumination of dial figures and panel inscriptions with a soft yet clear red light which does not over-stimulate the eyes during long periods of night flying, and therefore does not impair vision outside the aircraft.

A relatively thick sheet of acrylic plastic material is faced on its upper and lower surfaces by a thin sheet of translucent white plastic. On this sandwich is laid a thin sheet of opaque black plastic sheet and the whole assembly is then bonded to form a homogeneous panel.

Numerals, dials and inscriptions are engraved on the black plastic surface without piercing the white and therefore stand out clearly in white during daylight use. At night, use is made of miniature indicator lamps—fitted with "pea" bulbs—built into the panel at carefully selected positions. These lamps emit their light through a special red filter, and the light is transmitted throughout the thick acrylic sheet, thereby back-illuminating the white figures.



Diagrammatic section through "Plasteck" panel and lamp.

It is stated that no matter how the exterior lighting varies, from brightest sunlight to darkest night, the dials and their markings are clearly visible to the pilot, changing imperceptibly from white to red as dusk falls.

The system is very fully illustrated, by means of colour printing, in a brochure, *Equipment for Aircraft*, issued by the company. Also dealt with in this publication are other products of the Thorn Aircraft Components Division, including retractable landing lamps; navigation lamps for wing-tips, tail and fuselage; panel and indicator lamps; reverse-current cut-outs; sealed relays; thermal overload circuit breakers; portable fluorescent lighting; and non-glare ceiling lighting for control-tower interiors.

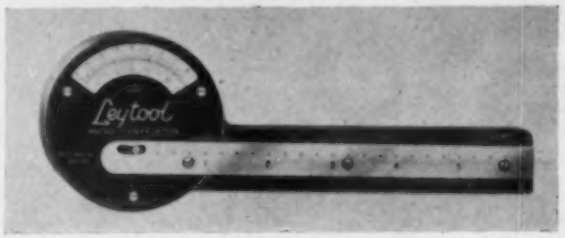
Scottish Celebration

CONTRARY to the more usual course of affairs a number of representatives from the aircraft industry in England crossed northward over the Border into Scotland at a recent week-end. Their purpose, however, was no more serious than to aid in celebrating yet another anniversary of the founding of the King Aircraft Corporation in Glasgow. Special trains were laid on, and every major firm in the industry was represented. Despite the very early morning arrival of the party from London, Mr. J. McEwan King was at the station to meet his guests, having dragged himself from a sickbed to do so.

The Saturday afternoon was spent in a tour of the works at Hillington, where all the various bits and pieces manufactured for aircraft and engine constructors were on show. In addition were a new lightweight flexible pipe coupling, and a push-pull control in which the operating core is a P.V.C.-covered wire cable. Both these items are under development by the company.

Sir Patrick Dollan, the principal guest at a dinner in the evening, forecast extensions of buildings and increases in staff next year. Every aircraft at Farnborough, he reminded his listeners, incorporated King Aircraft parts. Speaking of commercial aviation in Scotland, he remarked that three Viscount services a day between London and Glasgow were scheduled for next year.

Mr. McEwan King, being a good Scot, is as keen on "selling" Scotland as well as aircraft parts. To this end, he chartered boats to take the whole party for a sea trip round the Kyles of Bute, one of the finest scenic areas in the British Isles.



This new "Leytool" is employed for accurate (to 0.001in) setting of dividers by placing one point of the dividers in the appropriate hole on the inches scale and the other point in the movable hole seen near the left end of the scale; final setting is then obtained by use of the divider adjustment-screw and reference to the vernier scale. (Leytonstone Jig and Tool Co., Ltd., High Road, London, E.10.)

IN BRIEF

Two leaflets from the Plessey Co., Ltd., Ilford, Essex, deal with two types of H.F. fixed frequency receiver—the PR 51C and the PR 53; the latter is described in two variants, the 53A for frequency-shift telegraphy working and the 53C for R/T.

* * *

From the Ever Ready Co. (Great Britain), Ltd., come details of their new three-cell rubber spotlight torch, approved by the M.T.C.A. for marine use. It is stated to be waterproof, rust-proof and exceptionally robust.

* * *

The testing of aircraft engines, with particular reference to the inflammability hazard, is among the subjects dealt with in a new publication of the Factory Department of the Ministry of Labour, *Electrical Accidents and their Causes 1952, (Form 929)*. It is obtainable from H.M. Stationery Office at 3s.

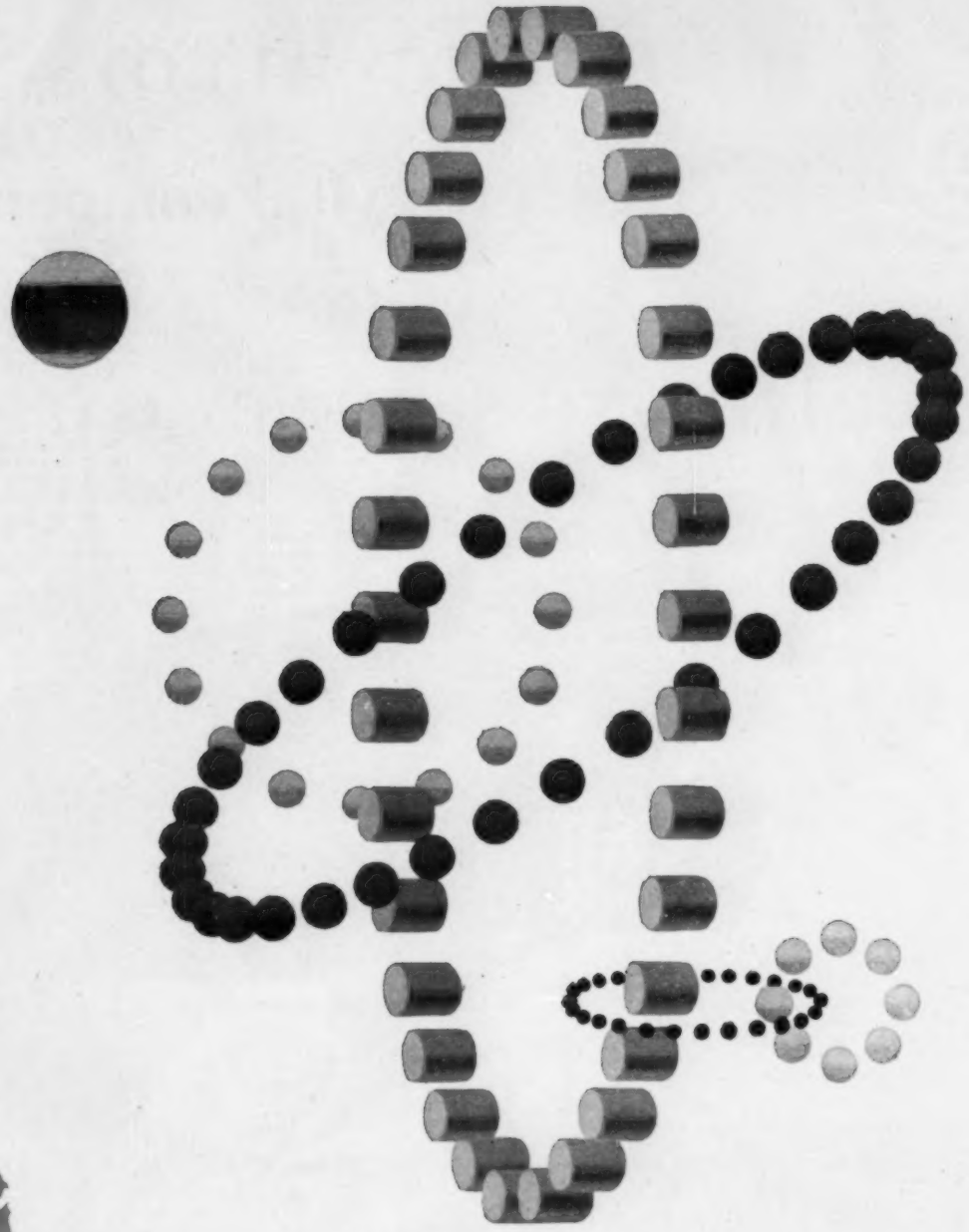
* * *

Mr. H. W. Bowen, O.B.E., M.I.Mech.E., M.I.P.E., former managing director of E.M.I. Factories, Ltd., and who recently acquired the firm of High Pressure Components, Ltd., is at present on a business tour of North America. He is discussing with the aircraft and other industries the H.P.C. products, which include specialized high-pressure valves and hose couplings.

* * *

As noted in our last issue, the new research office and laboratories of Export Packing Service, Ltd., were opened by Sir Edward Boyle, Parliamentary Secretary to the M.o.S., on Thursday of last week. Here research will be carried out into all types of packing, both in connection with materials and with the requirements of the various items dealt with. We hope to give some details of the laboratories in a forthcoming issue.

At Dunoon during the King Aircraft Corporation visit to the Kyles of Bute: (left to right) Mr. Ian McEwan King, Mr. C. C. Vinson (who joined the board only a fortnight ago), Miss Y. Harland, Mr. J. McEwan King, Mr. T. G. Llewellin and Mr. J. Love (See "Scottish Celebration", above).



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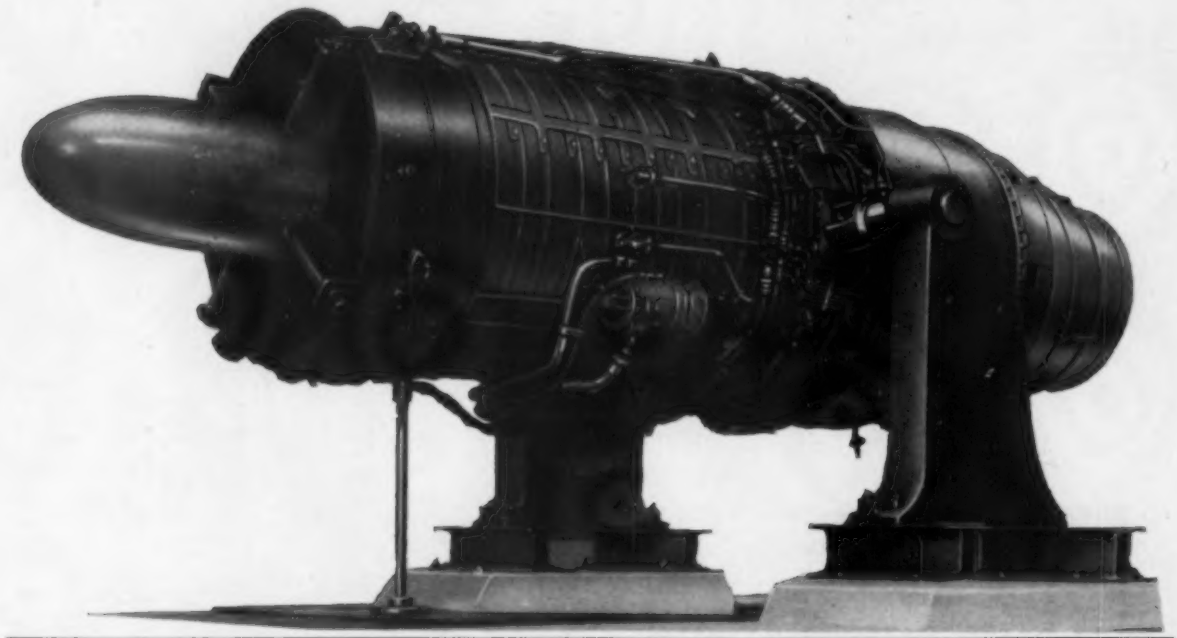

The Sapphire powers, among other aircraft, the English Electric P.1., the Gloster Javelin and the Hawker Hunter F.Mk.2. When Armstrong Siddeley first took over the development of this engine from Metrovick in 1948, it was the largest turbojet running anywhere in the world. Since then the design has been steadily improved—the latest type on which information has been released having a rating of 8,000 lb. thrust. The Sapphire is also in large-scale production in the U.S.A., as the Wright J.65.

As in all British aircraft gas turbine engines, Nimonic Alloys are employed to combat creep, fatigue and high-temperature oxidation.

Nimonic Alloys are used for the moving blades and other components of all British aircraft gas turbines.

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CIVIL AVIATION

TURBOPROP DC-7s FOR B.O.A.C.?

FOLLOWING an *American Aviation Daily* report last week of B.O.A.C. negotiations for at least ten Douglas DC-7 aircraft powered by Rolls-Royce turboprops, for delivery in 1959, official statements were made by both the Douglas company and B.O.A.C. The American company stated that "proposed sales of the turboprop version of the Douglas DC-7 air transports have been discussed by Douglas executives with B.O.A.C. in England, and with other airline officials. . . . The airplane discussed with that airline (B.O.A.C.) would be equipped with a powerful new British turbo-propeller engine produced by the Rolls-Royce company."

The Corporation's spokesman said "B.O.A.C. as an international operator must always watch with keen interest the development in any country of new types of aircraft which might be appropriate for commercial use at some future time, not only by the Corporation, but equally by its competitors—for we are engaged in a vigorously competitive world-wide business." After confirming that B.O.A.C. was informally discussing the potentialities of the Rolls-Royce turboprop version of the DC-7, the statement continued "this type might be available by 1958 or 1959, when the era of the large turboprop aeroplane—inaugurated, we hope, by the Bristol Britannia—will be an accomplished fact."

Readers of *Flight* may recall the mention of the projected DC-7D, powered by Rolls-Royce RB.109 turboprops, in our issue of August 6th. An American source was then quoted as giving the power of the new turboprop as approximately 4,400 s.h.p. The DC-7D was estimated to have a block speed of approximately 380 m.p.h. and a range of 4,300 nautical miles with 15,000 lb payload.

I.A.T.A. FARES SCHEDULE

THE majority of airline passenger fares for 1955-56 should remain at the present level, according to decisions reached at the traffic conference of the International Air Transport Association in Venice on Sunday last. Some increases—mainly in Europe—were found necessary in order to meet rising costs, however, while on certain routes, including those into and out of Jugoslavia, between Britain and Scandinavia, and between the Eastern Mediterranean and the Middle East, reductions in fares were to be introduced.

The polar service between Scandinavia and the West coast of the U.S.A. is included for the first time in the fares structure, the shorter distance resulting in a one-way fare reduction of about $18, or £6 9s, over that for the Atlantic route. Detailed tables of some 30,000 individual rates, which are to come into force on April 1st next year, are expected to be ready by November 26th. Government approval is required before the I.A.T.A. resolutions become effective.

The member-airlines failed to agree on North Atlantic cargo rates. Those airlines directly concerned, which number 13, are continuing their discussions. Freight rates in other parts of the world remain unchanged.

M. Michel de Villeneuve, vice-president of Air France and chairman of the conference, said that the fare increases would seldom exceed seven per cent, and would average a good deal less. Reductions would be as much as 20 per cent on existing fares over some routes. Tourist fares would be maintained about 20 per cent below first-class rates. European passenger fares would increase between 2.5 and 5 per cent, and rises of this order would appear also between Europe and Dakar, and between Europe and Madagascar.

NEW DOUGLAS ORDERS

ORDERS for Douglas aircraft recently announced include seven further DC-6A freighters for American Airlines, bringing the airline's total to ten, eight DC-7Cs (this type is named, appropriately, "Seven Seas") for the Arctic route of S.A.S., and two DC-7Cs for Swissair. American Airlines' purchase, announced exactly ten years after the company's first scheduled air freight service, will result in the new DC-6As entering service in the spring of 1956.

H.R.H. the Duke of Edinburgh emerges from the Prestwick Twin Pioneer prototype (two Alvis Leonides engines) with Mr. David McIntyre, managing director of Scottish Aviation. (See also page 603.)

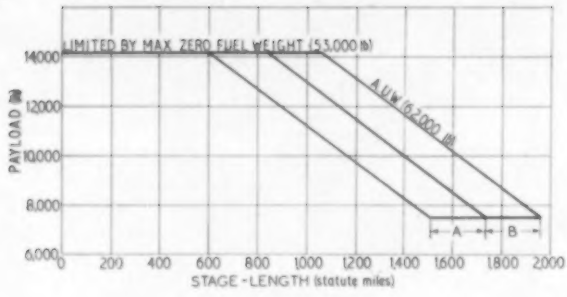
Taken from the control tower of the new airport at Dar-es-Salaam, Tanganyika, this "Flight" photograph shows a DC-4 of Sabena prior to its departure for Leopoldville. An account of the airport opening ceremony is given on page 630 of this issue.

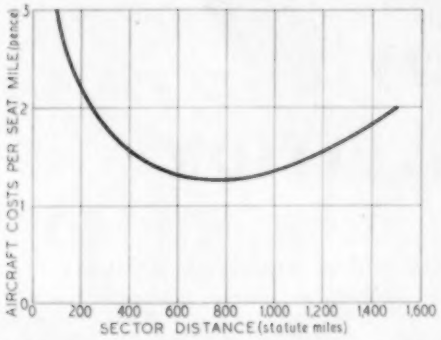
B.O.A.C.—UNITED AGREEMENT

A FREIGHT handling agreement, which facilitates cargo shipments between the midwestern states of the U.S.A. and Europe, has come into effect between United Air Lines and B.O.A.C. Under the agreement, both carriers accept and expedite shipments from the other at Chicago for flight forwarding to destinations through mutual acceptance of waybills. A weekly Stratocruiser flight is at present operated by B.O.A.C. between Chicago and London.

FIRST T.A.A VISCOUNT

NEWS of the arrival of the first T.A.A. Viscount in Melbourne last week was given in a cable message from Mr. G. P. N. Watt, chairman of T.A.A., to Mr. G. R. Edwards, chief designer of Vickers-Armstrongs. It read "Viscount *John Batman* arrived Melbourne on schedule the 13th after trouble-free ferry flight of 12,150 miles. Flying time 45 hr 45 min. Crew and passengers expressed great satisfaction with aircraft's performance and comfort. Appearance and finish aroused much favourable comment at ceremony on arrival."





Payload-range and cost characteristics of the Viscount 800 series. Left, payload (plus catering) versus range, with 400 lb fuel allowance for take-off, circuits and landing. Margin "A" covers a 200-mile diversion and margin "B" 45 min holding at 5,000ft on 4 engines; together they represent 1,950 usable gallons of fuel. Right: "aircraft" costs (direct operating costs) per seat-mile for B.E.A.'s V.802 version fitted with 65 seats.

Civil Aviation

THE VISCOUNT 800

FOLLOWING the appearance of new information on the developed Viscount 802 (the B.E.A. version of the Viscount 800 series) in the recently published B.E.A. report, further design and performance details of both the 800 and 802 have been released by Vickers-Armstrongs. The design specification of the new Viscount is somewhat different from that of the Viscount 801 announced in February 1953, advantage having been taken of the increased power from the new Rolls-Royce R.Da.6 engines. With an increased speed and improved take-off performance and range, the 800 series is claimed to be particularly suited to high-density short-haul routes.

Maximum payload of the 800 series is 14,200 lb over stage-lengths of up to 500 miles. In the opinion of the makers, the Viscount 700 and 800 series are complementary machines for medium-haul and short-haul operations respectively. The fuselage of the new Viscount will be 46in longer than the Viscount 700 and, in addition, the rear pressure bulkhead will be moved aft by 65in. This increased cabin space will enable 44-70 passengers to be carried compared with 40-59 in the present Viscount.

Wide variations in the amount of freight capacity provided at the forward end of the fuselage are possible, according to the passenger-space requirements, and the re-designed forward entrance door is rectangular and now measures 5ft by 4ft.

The B.E.A. version of the aircraft, the Viscount 802, in a 53-seat configuration, will have a maximum sector distance with full load of 950 miles. As mentioned, however, the basic seating layout is extremely flexible, and for shorter high-peak routes, the full total of 70 passengers and baggage can be accommodated. The maximum payload (passengers and freight) of the B.E.A. machines is 13,350 lb, which can be carried for 650 miles with full reserves.

Mr. Peter Masefield, chief executive of B.E.A., in his article in the current issue of the *B.E.A. Magazine*, says "The Viscount 802 is designed to be capable of carrying 70 passengers from London to Belfast, Glasgow, Edinburgh, Paris and Zurich, 62 to Nice, and 59 into and out of Jersey, with adequate runway performance. Like the Viscount 700 series, I believe that it will be a real winner."

The Viscount 802 is estimated to have the lowest direct operating cost per seat-mile of any aircraft in the B.E.A. fleet. B.E.A. calculations show that the total cost of operation of the Viscount 802 will vary from 4d. per seat-mile at 200 miles to 1.95d. per seat-mile at 750 miles. At a stage-distance of 950 miles, the maximum sector distance which the Corporation proposes to operate with a 53-seat version, the direct cost is 1.26d. per seat-mile and the total cost 2d. per seat-mile.

Twelve Viscount 802s have been ordered by B.E.A., who also hold an option for a further eight. The first machine of this type, the manufacturers state, is due to be delivered in June 1956.

Details of the 800 series, together with comparable figures for the 700D now being produced and the 701 now in service with B.E.A., are given below.

	800 Series	700D	701
Span	94ft	94ft	94ft
Length	85ft	81ft 2in	81ft 2in
Max. take-off weight ...	62,000 lb	60,000 lb	57,000 lb
Max. landing weight ...	57,000 lb	54,000 lb	52,000 lb
Max. empty weight ...	37,800 lb	35,100 lb	34,500 lb
Fuel capacity	1,950 Imp. gal	1,950 Imp. gal	1,720 Imp. gal
Fuel capacity with slipper tanks	2,240 Imp. gal	2,240 Imp. gal	n.a.
Engines	4 Dart R.Da.6 Type 510	4 Dart R.Da.6 Type 510	4 Dart R.Da.3 Type 505
Take-off power	1,697 e.h.p.	1,697 e.h.p.	1,547 e.h.p.
Cruising power	942 e.h.p.	942 e.h.p.	862 e.h.p.
Seating capacity	44-70	40-59	40-59
Max. payload	14,200 lb	12,800 lb	10,700 lb
Max. still-air range with max. payload	1,060 miles	1,450 miles	1,020 miles
Max. still-air range	1,960 miles (7,500 lb payload)	2,190 miles (8,200 lb payload)	1,530 miles (8,000 lb. payload)
Average cruising speed ...	318 m.p.h.	321 m.p.h.	302 m.p.h.
Engine failure take-off distance at max. weight ...	1,860 yd	1,730 yd	1,830 yd
Fuel consumption	309 gal/hr	309 gal/hr	282 gal/hr
Max. zero-fuel weight ...	53,000 lb	49,000 lb	48,000 lb

SHORT-HAUL PROBLEMS: MORE FROM B.E.A.'s REPORT

THE main features of this year's B.E.A. report* were recorded in last week's issue of *Flight*. They included the news that while a record number of 1,656,779 passengers were carried, the Corporation's net deficit increased by 21.6 per cent to £1,773,797. We print below some further extracts from the report which, as in previous years, is probably the best example published of what an airline report should be—complete, extremely detailed and genuinely frank.

The total of 53.6 million load ton-miles which were sold, the report states, represented an increase in traffic of more than 23 per cent compared with the previous year. The Corporation was proud to record the achievement of one of its major objectives—a year with a 100 per cent safety record completed in flying 161,290 revenue hours, during which 214,488 take-offs and landings were made, in the course of flying some 24 million aircraft miles.

After referring to the introduction of the Viscount into regular service—"the outstanding event of the year for B.E.A."—the report continues: "B.E.A.'s output during the year, measured in capacity ton-miles flown, increased by 20.7 per cent to a total of 83.6 million c.t.m. This production was achieved during a year in which the total revenue hours flown were reduced by 6.4 per cent—the result of the introduction of new and faster aircraft. For example, the Viscount produced 1,064 c.t.m. in each hour flown, compared with the 452 per hour of the Viking.

"The total cost of each ton-mile produced during the year was reduced by 6.1 per cent—from 50.6d to 47.5d per c.t.m.—by dint of rigid economy and concentration on improving the airline's productive efficiency . . .

"The reduction in the cost of each ton-mile flown, and the achievement of a higher load factor, were sources of satisfaction as tangible results from many labours. Their effect was, however, offset financially by the steep fall in the revenue rate, which fell more sharply than the reduction in the cost. The lower revenue rate was a result of an international decision to introduce tourist fares extensively throughout Europe from April 1st, 1953. Thus, in a year in which the specific cost was driven down by 6.1 per cent, the revenue rate fell by 8.5 per cent, from 69.7d to 63.8d for each load ton-mile sold. Operating revenue was increased, nevertheless, by £1,645,090 to a total of £14,773,170.

"Against this background, and before charging amortization and depreciation, B.E.A. had shown for the first time a small operating surplus, which amounted to £64,000. This compares with a loss of £450,000 on the same basis in the previous year. During the year, however, B.E.A. had to provide for an increase

* *British European Airways Report and Accounts for the Year Ended 31st March, 1954. H.M. Stationery Office. Price 5s.*

of nearly £500,000 in aircraft amortization charges. Taking this into account, the net deficit for the year was £1,773,797 against which B.E.A. can set the Exchequer grant of £1,500,000. This result compares with a net deficit of £1,459,131 in 1952-53, against which there was an Exchequer grant of £1,250,000."

The report goes on to list the major items of cost, which in total increased by 48 per cent during the year. These include £913,000 for aircraft amortization, £685,000 for staff pensions, £619,000 for gross interest on capital, £437,000 for fuel tax and £248,000 for M.T.C.A. landing fees.

Helicopter operations, the report states, had been maintained in addition to B.E.A.'s normal commercial services. Three American Sikorsky S-51s had been replaced by Bristol 171 Mk. 3A machines, and the two Bell 47Bs remained in service.

Concerning long-term helicopter developments, B.E.A. was following closely the civil development of the Sikorsky S-56, the Fairey Rotodyne, and a projected 50-passenger Douglas helicopter powered with British turbine engines, in addition to the turbine-powered developments of the Bristol 173.

The report continues: "Regularity and punctuality improved to new high standards during the year. In all, 97 per cent of the services scheduled were operated—a 2.9 per cent improvement in regularity over 1952-53—while 81 per cent of all services arrived within 15 minutes of the scheduled time, compared with 76 per cent in the year before . . ."

Discussing the problems peculiar to short-haul operations, the report gives the figures shown below.

Although B.E.A. believed that long-route profits would in time offset losses on short domestic sectors, the very low average domestic fares illustrated the main difficulty. Fuel taxes and landing fees for a Douglas DC-3 operated in the U.K. were 17.3d per aircraft mile and £5.6 respectively, compared with about 1.3d and £1.1 in the U.S.A., and a high utilization was difficult to achieve on short journeys. Clear profits were made on the combined results of all routes having a sector distance more than 260 miles, and a loss was incurred on all routes short of that distance.

After discussing the problem of traffic peaks as it affects B.E.A.'s high-density short-haul operations, the report gives an account of the steps being taken to meet these difficulties. These steps included the forthcoming introduction of the Viscount V.802. The report is completed by detailed accounts of the work of the various departments and by a valuable selection of graphs and appendices.

	All B.E.A. Services	International Services	Domestic Services
Average stage-length (miles)	223	306	135
Average flight duration	1 hr 30 min	1 hr 55 min	1 hr 5 min
Average one-way fare	£7	£10	£3.6
Revenue rate per passenger-mile	5.8d	6.4d	4.6d
Ratio of summer to winter traffic	1.75:1	1.61:1	2.14:1

Amplifying the report, further comment on the reduction in the revenue rate received by the airline during 1953/54 was given in London last week by Lord Douglas (chairman) and Mr. Peter Masefield (chief executive). Although B.E.A. had been in favour of the introduction of European tourist services, it was now their opinion that the large, flat reduction of fares should not have been immediately and universally applied.

The financial results for the first half of the current financial year, Lord Douglas stated, were an improvement. Over 1,220,000 passengers had been carried, and a clear profit of £1,100,000 (compared with £484,000 for the corresponding period last year) had been achieved. All of this would unfortunately be swallowed up by the losses of the winter months, but this winter loss should not exceed £2 million, and the overall net deficit for the current financial year should be less than half of that for 1953/54. It was difficult to state when the Corporation would "get out of the red," but this would most probably be between 1957 and 1959.

B.E.A. COMPARATIVE STATISTICS SUMMARY

	1953-54	1952-53	Percentage Variation
Traffic revenue ...	£14,256,091	£12,638,293	+12.8
Operating revenue	£14,773,170	£13,128,080	+12.5
Expenditure on Operating Account	£15,975,721	£14,285,771	+11.8
Total expenditure ...	£16,546,967	£14,587,211	+13.4
Net deficit	£1,773,797	£1,459,131	+21.6
Capacity ton-miles offered	83,593,253	69,230,611	+20.7
Load ton-miles sold	53,594,689	43,544,039	+23.1
Load factor	64.1 per cent	62.9 per cent	+1.9
Total cost per c.t.m.	47.5d	50.6d	−6.1
Traffic revenue per c.t.m.	40.9d	43.8d	−6.6
Passengers carried ...	1,656,779	1,400,122	+18.3
Revenue passenger miles	480,065 449	372,966,170	+28.7
Mail ton-miles ...	2,601,317	2,541,209	+2.4
Freight ton-miles ...	5,556,773	5,261,659	+5.6
Revenue hours flown	161,290	172,280	−6.4
Revenue utilization (hours per annum)*	1,480	1,512	−2.1
Aircraft miles flown	23,826,697	24,235,484	−1.7
Average number of employees ...	9,052	8,551	+5.9
C.t.m. per employee	9,235	8,096	+14.1

*Excludes helicopter operations.

FROM THE CLUBS

SEPTEMBER'S hours at the Elstree Flying Club—221½—brought the total to 2,125 for the first nine months of this year. Courses are being arranged at Elstree to cover flying and ground training for instructors' ratings, and are due to start in mid-November. Pilots interested should contact the C.F.I. as soon as possible. Night-flying activities were reduced during the long summer evenings, but they are now being renewed, with instruction available on both Auster and Hawk Trainer on two nights per week.

A new series of student pilots' lectures, covering the syllabus for the written and oral P.P.L. tests, will take place on Wednesday evenings, beginning in early November. The club's next party is planned for November 4th.

HONORARY President of the recently-formed Thorney Island Flying Group is A.V-M. G. E. Nicholetts, C.B., A.F.C., Other members of the committee include S/L. D. T. Lees, M.C. (chairman), F/L. A. Dicker (secretary) and F/L. E. Binks (treasurer); the instructors are F/L. T. Palmer, F/L. J. Greenleaf, and F/L. J. Cermak; and F/S. J. Hayton is the ground engineer.

Fair progress on the flying side is reported, and well-attended ground instruction classes for students have been held. Instructional flying now takes place on Sunday mornings and Wednesday and Saturday afternoons; at other times the Hawk Trainer is available to members at 30s per hour. The initial subscription has now been reduced from £3 10s to five shillings per month. The formation of a constructional group is being considered by some members of the group, who have their eyes on the French "Turbi" low-wing two-seater.

THE seventh annual "Round-up Flight" rally sponsored by the American Aircraft Owners and Pilots Association took place at Nantucket Island, Massachusetts, last month. Owing to the movement of the hurricane "Edna," the rally was postponed by a week: continuing bad weather, however, confined the attendance to 463 people in 200 light aircraft, whereas the number of original reservations had exceeded 1,300.

The programme included demonstrations of current types of American private aircraft, including the Piper Apache, Piper Tri-Pacer, Beech Bonanza, Cessna 170 and Aero Commander: a number of further machines intended for display were prevented by the bad weather from attending. Stated to be the "biggest yearly vacation flight in private aviation circles," the rally is organized for members and non-members of the A.O.P.A., which has a present membership of 40,000 civilian pilots.

AT the recent 47th conference of the Fédération Aéronautique Internationale in Istanbul, at which Capt. K. J. G. Bartlett was elected as the new president, the retiring president, Mr. C. Kolff, became president of honour. The new "first vice-president" is Surgeon-General C. Sillevaerts of the Royal Aero Club of Belgium, and the following ordinary vice-presidents were elected: Miss Jacqueline Cochran (U.S.A.), M. Jacques Allez (France), Don Luis F. Ardois (Cuba), Dr. W. Muri (Switzerland), Mr. Mustafa Zeren (Turkey), Mr. C. Kolff (Holland), Maj. R. H. Mayo (Great Britain), Gen. N. Del Duca (Italy), Don Francisco Gutierrez Delgado (Spain), Capt. John Foltmann (Denmark), Mr. Branko Ivanus (Yugoslavia), Mr. E. Stepanov (U.S.S.R.), Maj. Oscar van Reichel von Erlenhorst (Austria), Lt-Col. Theophilis (Greece).

Almost every aspect of sporting and private aviation was discussed by the various committees during the conference. Among the problems debated by the sporting committee was the measurement of speed records at great heights, and a proposal for the organization, every three or four years, of a F.A.I. "gathering of aviation sports" was accepted in principle.

The touring committee discussed methods of simplification of international air touring, and adopted a new Air Tourist's Card, asking the F.A.I. to make it available for clubs which wished to use it. A proposal submitted by the U.S.A. for a big air rally and tour in 1955 as part of the celebrations for the 50th anniversary of the F.A.I. was put down for discussion with the clubs concerned.

TANGANYIKA'S NEW TERMINAL

Dar-es-Salaam Airport Officially Opened

ON Saturday last, October 16th, a fine new airport for Tanganyika's capital, Dar-es-Salaam, was officially opened to civil traffic. Promptly at 0930 hr a Survey Prince of the Tanganyika Government, VR-TBC *Prince Rupert*, touched down on the 6,800ft main runway; from it disembarked H.E. the Governor, Sir Edward Twining, and the Secretary of State for the Colonies, Mr. A. T. Lennox-Boyd.

The scene was most impressive, reports *Flight's* representative. Brilliant sun poured between massive white clouds on to the neat new airport and its colourful assembly of people and aircraft. The rows of aircraft included three transports which had "unofficially" arrived before the ceremony: East African Airways' DC-3 VP-KJU *Sagana II*, in which H.M. the Queen flew earlier this year; B.O.A.C. Argonaut G-ALHD *Ajax*; and a Leopoldville-bound Sabena DC-4. *Ajax* had completed the previous day's scheduled London-Nairobi service before continuing straight through to Dar-es-Salaam. The passengers included B.O.A.C.'s representative at the ceremony, Lord Rennell of Rodd, a member of the Board.

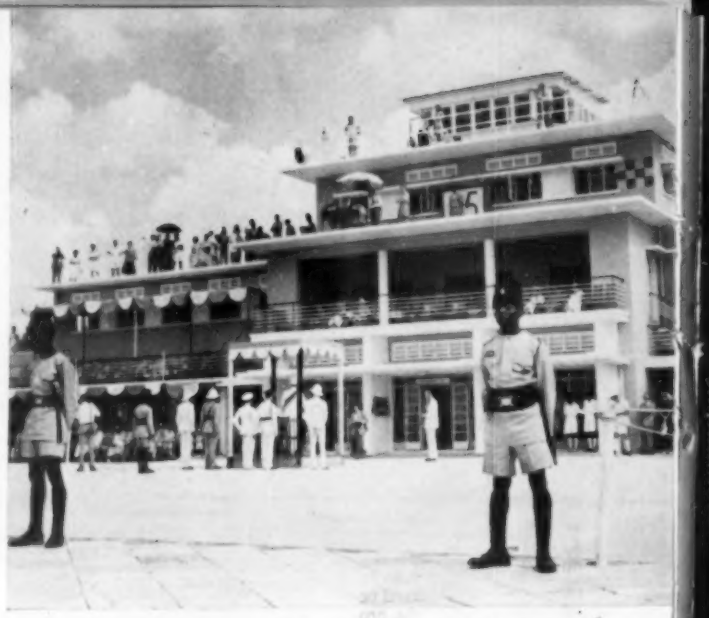
Drawn up before the terminal building were a band and guard of honour from the King's African Rifles. Looking-on were a large and cosmopolitan crowd of Europeans, Asians and Africans, many of whom had journeyed from far up-country for their first close view of an aeroplane.

After inspecting the guard of honour and shaking hands with members of the constructional staff, the Governor made a brief speech. He recalled that though Mr. Lennox-Boyd was originally invited to the opening as the Minister for Transport and Civil Aviation, his presence as Secretary of State for the Colonies had brought even greater delight. Mr. Lennox-Boyd's previous visit to Tanganyika, in 1952, was still memorable; the Africans, by nicknaming him "Bwana Kilimanjaro" associated him with the greatest and most pleasing natural feature in the territory. Tanganyika, said the Governor, was one of the most air-minded territories in Africa, having no fewer than 35 Government and 12 private airfields. He hoped that operators would make increasing use of the new airport, which was the second of three major communications projects (the first being the Dar-es-Salaam/Morogu road and the third the provision of deep-water berths in the harbour, now well advanced). The airport had been built in good time and, considering how expensive modern airports could be, for a relatively modest sum (around £¼m).

Before unveiling a commemorative plaque, Mr. Lennox-Boyd paid a graceful tribute to the pioneers of East African civil aviation since the landing at Tabora on February 28th, 1920, of a Vimy Commercial. The management and control of the airport, he said, was in capable hands, and Dar-es-Salaam would play a vital part in improving East African communications, upon which the wealth and happiness of this great country depended.

Mr. Lennox-Boyd, Secretary for the Colonies, pictured after unveiling a commemorative plaque in the entrance to the terminal building.

"Flight" photographs



"Flight" photographs

Top, a view of the Dar-es-Salaam terminal building. The lower photograph shows the Tanganyika Government's Hunting Percival Survey Prince which brought Sir Edward Twining and Mr. A. T. Lennox-Boyd.

There followed a two-hour flying programme representative of the many-sided activities of East Africa's large operators, small companies and private owners. The Survey Prince, one of two giving good service to the Government, showed both its single-engined performance and reversing ability on touch-down. Club flying was represented by a Chipmunk and Auster of the East Africa Aero Club, based at Nairobi. Major Lovett-Campbell's steep climbing turns in his Nighthawk brought excited laughter and clapping from the African and Asian section of the crowd. Two smart red-and-silver Bonanzas were demonstrated by two of Noon and Pearce Air Charters pilots, May and Wood, and this company's managing director, Mr. Alec Noon, showed off the very lively performance of one of his lately acquired Queen 2 Rapides. (The Editor flew this aircraft last year and gave his impressions in our issue of November 20th.)

Campling Bros. and Vanderwal, another leading East African charter company, contributed a Macchi 320, which took off and climbed away on one engine, and two Cessnas—a 170 and 180. Both these aeroplanes impressed with their short take-off and steep climb under high-temperature conditions, one of the factors behind the popularity of American light aircraft in this part of the world. The Macchi was flown by Mr. Boskovic, the Cessna 170 by Mr. Campling and the 180 by Roy Marsh (of Hemingway fame).

"Corporate" ownership was represented by the Rapide of Sir Alexander Gibb and Partners, the airport contractors (pilot, Wellby) and the Williamsons Diamond Mines Dove, flown by Mr. Mansfield. The photographic Anson of Hunting Aerosurveys was put through its paces very thoroughly by Capt. Pearson; one almost saw the drops of perspiration on its glazed nose. *Sagana II* was demonstrated by E.A.A.C.'s chief pilot, Capt. Morris, whose low runs showed great confidence in the DC-3s single-engined performance. The company's excellently maintained ten DC-3s are all relatively new and are expected to continue in service for at least five years.

To conclude the flying programme came a lengthy demonstration by four Vampires from R.A.F. Middle East. Later in the day *Ajax* made two 45-minute demonstration flights with Capt. Raeburn in command and 40 guests aboard on each occasion. The Argonaut made a fine picture—a travel poster come to life—as it swept over the palm-fringed blue waters of the harbour.

A page from
THE ESSO HISTOIRE OF AERIAL LOCOMOTION
Adapted from the French de P. Crochet-Damais. Illustrated par Philippe Féty avec permission.

PÈRE FRANCESCO LANA AND HIS DREAM-SHIP

PÈRE FRANCESCO LANA, the Jesuit scholar, has some claim to be considered another of the pioneers of aeronautics. In 1670, at Brescia, he published a novel work, the "Arte Maestria" in which he outlined a project for an aerial ship. It would consist of a coracle-shaped hull powered by four vacuum flasks, or spheres of tin-plate from which the air had been exhausted by means of a pump. These globes were to be moored to the skiff by means of cables, and the whole contraption was to be steered by the helmsman or pilot armed with an oar and a bit of a sail. It was a splendid, breath-taking conception.

Naturally enough Père Francesco Lana's flying-boat created quite a stir. His plans were reproduced in many works, Leibnitz and others wrote at length on the scientific, political and social possibilities of the "navire aerostatique." And when Père Lana announced that his plans would soon be converted into a practical machine capable of exploring interplanetary space enthusiasm knew no bounds.

But as always there were those who predicted failure and catastrophe, and the good Father at length became discouraged. We do not know whether his dream-ship ever left the drawing-board, but he had done quite enough, as they say in France, to win eternal fame as "le précurseur de nos modernes astronautes."

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BARRYMOUNTS

"Flight" photograph
Two rescue launches of the R.A.F. Marine Branch lying in Plymouth harbour opposite R.A.F. Mount Batten, the home of the Training School and Rescue Control Centre, whose work is described in an article on pages 616-617 of this issue.

SERVICE AVIATION

Royal Air Force and Fleet Air Arm News

Royal Rhodesian Air Force

THE above is the new title of the Southern Rhodesia Air Force as from October 15th, according to an announcement recently made in Salisbury. The Queen has given permission for the prefix "Royal." (An article on the S.R.A.F. appeared in *Flight* of July 2nd last.)

At the same time the Southern Rhodesian Women's Military and Air Service has become the Rhodesia and Nyasaland Women's Military and Air Services.

The R.R.A.F. is to adopt R.A.F. ranks in place of the Army ranks used hitherto.

Pre-assessment Scheme

SINCE the Royal Air Force pre-assessment scheme was first introduced in 1951 some 3,200 applicants have been assessed as suitable for aircrew duties, and 40 per cent of these have entered the Service.

The scheme allows for 16-year-old boys of good education, and who have the ambition to fly, to spend two days at Hornchurch, where they take various tests and medical examinations and their suitability for aircrew duties is pre-assessed. Fares and accommodation charges are paid by the R.A.F., but the boys do not enter into any commitments to serve. Applications may be made through headmasters or an R.A.F. Recruiting Office.

A Sea Venom Mk. 21 recently carried out deck trials on H.M.S. "Albion" and is shown here about to be launched from the starboard catapult. Although "Albion" is an operational carrier, it will be remembered that the D.H.110 made its first "touch-and-go" approaches on the same vessel, as related in "Flight" of October 1st.

R.A.F. Civic Associations

SINCE March 1939 many towns have adopted neighbouring R.A.F. stations and to date, including auxiliary squadron associations, 100 R.A.F. stations are so connected. Seven more stations are now to be adopted: Pembroke Dock by Pembroke, Ballykelly by Londonderry, St. Eval by Bodmin, St. Mawgan by Newquay, Sandwich by Sandwich, Turnhouse by Edinburgh and Chivenor by Barnstaple.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments announced by the Air Ministry:—

G/C. W. D. Disbrey, C.B.E., A.F.C., to H.Q. Bomber Command, for technical staff duties.

Wing Commanders: L. T. Card, to H.Q. Fighter Command, for technical staff duties (with acting rank of group captain); T. Balmforth, D.F.C., A.F.C., to Air Ministry for duty in the department of the Chief of Air Staff; A. F. Binks, D.F.C., to H.Q. Southern Sector, for air staff duties; R. E. Sharp, D.F.C., to St. Eval, J. M. Southwell, D.F.C., to Geilenkirchen, and F. Aikens, A.F.C., to R.A.F. Kuala Lumpur, all for administrative duties; P. D. W. Hackforth, to H.Q. No. 64 Group, for air staff duties; J. W. Lovell, to H.Q. No. 42 Group, for administrative staff duties.

R.A.A.F. Redeployment

THE Australian Vampire Unit in Malta, No. 78 (Fighter) Wing, is to move back to Australia early in 1955. The move was originally scheduled for the end of this year but the Unit will now reach Australia in February, travelling in three ships. While in Malta No. 78 Wing has gained the distinction of winning the Governor's Cricket Trophy for three years in succession, the first time that this has been achieved since the competition started in 1901.

Lord de L'Isle and Dudley, V.C., has

SERVICE AVIATION . . .

said that No. 78 Wing upheld the highest traditions of the R.A.A.F. and that the unit has been "most welcome" in the Middle East Air Force.

No. 77 Sqn., which spent three years on active service in Korea, is also to move back to Australia. The squadron was first equipped with Mustangs and then converted to Meteors and can claim no fewer then three Mig-15s destroyed and seven "probables" of other types, together with the destruction of 3,700 enemy buildings, 1,400 vehicles, 98 units of railway rolling-stock and 16 bridges. Over 40 Meteors will go back to Australia with the squadron. Casualties during the three years included 16 pilots killed in action and 18 reported missing.

No. 201 is Forty

ALTHOUGH No. 201 celebrated its fortieth birthday on Friday last there was no sign of this squadron being other than youthful, as it always is. The chief guest of the evening was A.V-M. G. B. Tuttle, C.B., O.B.E., D.F.C., A.O.C. No. 19 Group, who had flown over from Mount Batten to Pembroke Dock, and there were a number of past members present, including Capt. Sykes, who was a pilot with the squadron in the 1914-18 war. Unfortunately Sir Arthur Longmore, 201's first commanding officer, was unable to be present.

In the best 201 Squadron tradition, and on cries of "Up, up, up!" all speeches were delivered from a table-top stance. G/C. W. P. Welch, Station Commander at Pembroke, gave a brief résumé of the history of the squadron from the time of its inception as No. 1 Sqn., R.N.A.S., in 1914 to the present time. He disclosed, also, that the present C.O., S/L. R. A. N. McCready, would soon be leaving. [S/L. McCready was with 201 in 1943, as second pilot to F/L. T. N. Stack, and left in the spring of 1946. He came back to the unit in 1952 and it is now possible that he will have an Operations Requirements (Maritime) appointment at the Air Ministry].

Replying for the squadron, the C.O. said that, "as the representative of a long line of managers," he considered the squadron deserved all the compliments expressed.

Although A. Cdre. C. G. Wigglesworth, C.B., A.F.C. (who commanded the squadron in 1933) was to have spoken for the past members, he stepped down in favour of Capt Sykes, who recalled conditions as they were in the squadron 36 years ago, comparing them with present-day complexity. Capt. Sykes retold the story of Major Barker winning the V.C.—still fighting when both legs and one arm were out of action—and of the exploits of Capt. Kinkead. At that time, Kinkead was a flight commander and he had the playful habit of getting his flight in line astern and then making them follow him in evolutions both spectacular and difficult. He eventually lost his life while practising for the Schneider Trophy contest in 1927.

A.V-M. Tuttle, who spoke for the visitors, said No. 201 "had now had everything." It started with wheels, it now had boats and might finish up with nothing at all—an allusion to the non-replacement of the Sunderlands when they finally go out of service in three or four years time. His last remark was that, whatever No. 201 had to do, it would be good at it.

In the ante-room after dinner S/L. McCready, aided by past commanding officers G/C. K. R. Coates (1944), A. Cdre. C. G. Wigglesworth (1933) and W/C. J. W. Louw (1945) cut a 4ft "birthday cake" to reveal a barrel of "Liffey water."

(An illustrated history of No. 201 Squadron was published in *Flight* of April 11th and 18th, 1952.)

No. 141 Squadron History

THE history of No. 141 Sqn. is to be rewritten, and those who have any information or photographs likely to be of interest are asked to communicate with the Commanding Officer, R.A.F. Coltishall, Norwich, Norfolk.

Amberley Development

BY August of next year, it is expected, R.A.A.F. Station Amberley, Queensland, will have become the biggest bomber base in the southern hemisphere.

The base is now in process of being remodelled. Wartime huts are being removed and permanent buildings erected. At present the personnel number 1,300 men, but this figure is likely to be increased to 2,000.

No. 2600 Squadron H.Q.

LAST Saturday, October 16th, No. 2600 (City of London) L.A.A. Squadron, R.Aux.A.F. Regt., of which the Queen Mother is Honorary Air Commodore, opened their new headquarters at Biggin Hill.

The ceremony was performed by Air Marshal Sir Harold T. Lydford, K.B.E., C.B., A.F.C., A.O.C-in-C. Home Command. He was accompanied by A.V-M. F. J. St. G. Braithwaite, C.B.E., A.O.C. No. 61 Group and W/C. D. G. Smallwood, D.S.O., M.B.E., D.F.C., Officer Commanding Biggin Hill. The C.O. of the squadron is S/L. D. J. H. Howard.

Since the unit left Stanmore Park, where it was raised, it has already had two changes of headquarters. The new accommodation includes spacious offices, lecture rooms, stores and, of course, a canteen.

During the opening ceremony Sir Harold presented the British Empire Medal to Sgt. F. Manning in recognition of his work with No. 2600 Squadron since joining the unit in its very early days.

Air Marshal Sir Harold T. Lydford presenting the B.E.M. to Sgt. F. Manning of No. 2600 Squadron.

A.V-M. C. A. Stevens

AFTER 38 years service in the Royal Flying Corps and Royal Air Force, A.V-M. C. A. Stevens, C.B., C.B.E., M.C. and Bar, retired on Monday last.

Since September 1951 he has been S.A.S.O. at Home Command and before that commanded No. 62 (Southern) Group and No. 28 Group.

No. 500 Squadron Presentation

MR. ANTHONY EDEN, Honorary Air Commodore of No. 500 (County of Kent) Sqn., presented a silver model of a Meteor to S/L. Desmond de Villiers, A.F.C., who recently resigned as the squadron's commanding officer. The presentation was made at a dining-in night at the Maidstone headquarters. After dinner Mr. Russell Adams, chief photographer of Gloster Aircraft and an honorary member of the squadron, showed a series of air-to-air films made during the squadron's annual camp at Malta.

L. G. Groves Prizewinners

THE following have won L. G. Groves Memorial Prizes and awards this year: *Aircraft Safety:* S/L. W. H. Forster, A.F.C., R.A.F. Station Prestwick. *Meteorology:* G. A. Corby, B.Sc., Principal Scientific Officer, Meteorological Office, Dunstable. *Meteorological Air Observer:* Sgt. J. A. McCubbin, R.A.F. Station, Aldergrove, N. Ireland.

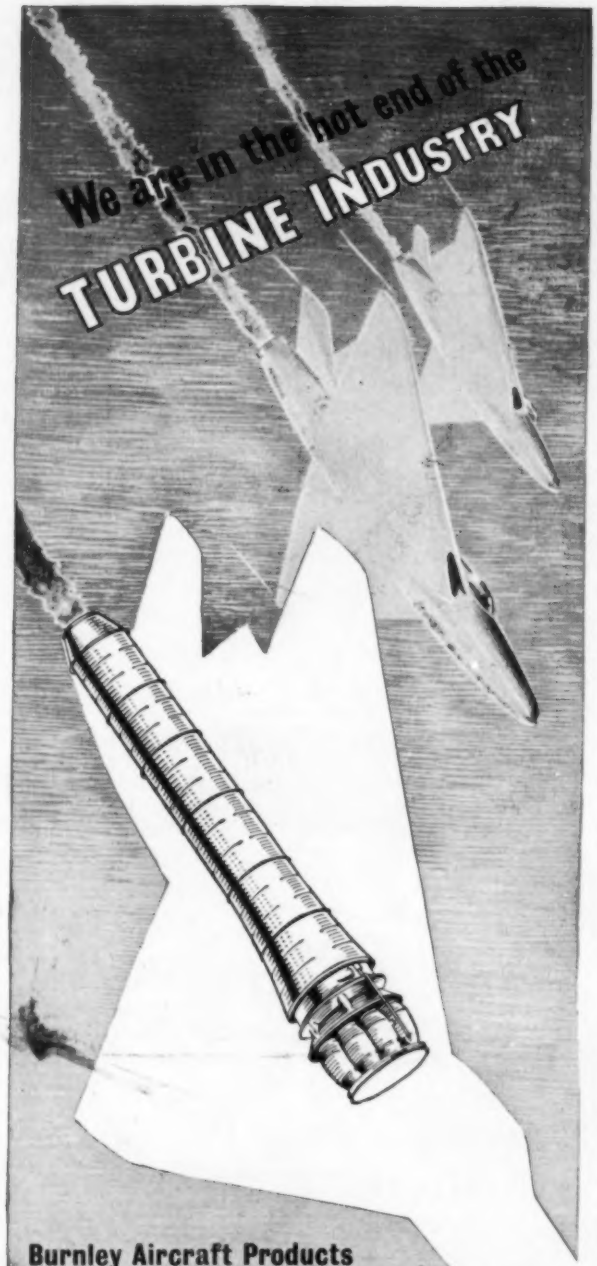
While Principal Air Traffic Control Officer at Watnall, S/L. Forster developed a number of procedures for handling aircraft emergencies and combined these in a guide for control officers. His work resulted in a considerable reduction in the time taken to fix an aircraft in distress.

The meteorological service at Northolt under Mr. Corby was considered to be of a standard unexcelled elsewhere, and Sgt. McCubbin's award is for meritorious work while serving with No. 202 Squadron.

Naval/Air Reunion

A REUNION of F.A.A. and R.A.F. personnel who served at the U.S.N. Air Station Pensacola, Florida, during the war will be held in London on November 20th. Details for L. V. Armstrong, 47 Rutland Road, London, E.11.

In traditional style S/L. R. A. N. McCready replies on behalf of No. 201 Squadron. Seated are A.V-M. G. B. Tuttle, F/L. South, G/C. W. P. Welch and A. Cdre. C. G. Wigglesworth. (See "No. 201 is Forty," above).



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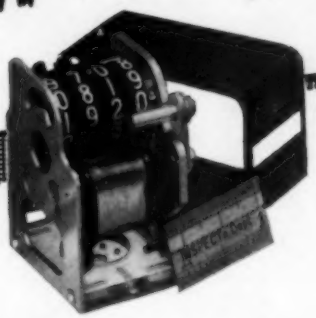

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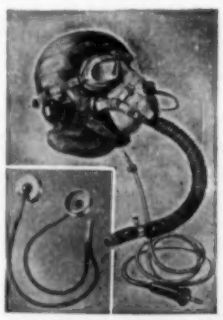

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APPLICATION No. 393. For a Seasonal Normal Scheduled Service with Pionair, Elizabethan and/or Viscount aircraft for the carriage of passengers, supplementary freight and mail between London and Malta with an intermediate traffic stop at Ajaccio at a frequency of from two to seven services weekly during the season from April to September inclusive, each year, for a period of 10 years, commencing April 1st, 1955.

APPLICATION No. 394. From Dragon Airways, Ltd., of Speke Airport, Liverpool. For a Seasonal Vehicle Ferry Service with Bristol 170 aircraft for the carriage of vehicles, passengers and supplementary freight between Liverpool (Speke) and Belfast (Nutts Corner) with an intermediate traffic stop at Isle of Man (Ronaldsway) at a frequency of from two to seven services weekly during the season from June to September inclusive, each year, for a period of seven years, commencing June 4th, 1955.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3, Dean's Yard, London S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [2767

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required for a number of posts in the Research and Design Laboratories of an advanced Guided Missile project. The work is interesting and prospects for advancement are good. For most of these posts graduates are required, or applicants holding National Certificate or City and Guilds with some practical experience. Lack of these qualifications should not prevent application being made as each case will be considered on its merit. (Ref. 80.)

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required in a Guided Missile project for research and development work. Qualifications must include a degree in physics and two years' industrial experience for the senior posts and Inter B.Sc. or equivalent for the junior posts. Knowledge of electronics an advantage. (Ref. 81.)

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for mechanical design, development and construction of up-to-date sub-miniature equipment. The work is of a practical nature but knowledge of Drawing Office procedure an asset. There is also an opportunity for the development of the latest techniques in connection with this work. (Ref. 82.)

Please write in detail, quoting reference number of position sought, to:—

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(Technical Employment)

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Salary will be commensurate with qualifications and experience, full details of which should be sent to:—

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Senior Design Draughtsmen. Preferably with sound knowledge of Aircraft design. Men with experience of light mechanical design considered.

Loftsmen. Must be experienced on full scale layout work on Aircraft.

Test Engineers. To carry out Structural and Mechanical Tests.

Please send full particulars of experience, etc., to the Personnel Officer.

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SITUATIONS VACANT

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APPLICATIONS are invited for the following vacancies:

1. Technical assistants for initial design work on the following projects:
   (a) Turbo propellers
   (b) Air and gas turbines for aircraft auxiliary power supply
   (c) Controllable pitch marine propellers
   (d) Fractional and medium horse power electric motors, synchronising and control devices and instrumentation.
2. Development engineer for the electrical and general instrumentation aspects of the development programme on guided weapons.
3. Senior test engineers, preferably with servo experience for work on guided weapons.
4. Senior stressmen.
5. Junior stressmen.
6. Electrical design engineer for new electrical design work and control of detail design.

FOR these vacancies, applicants should preferably be university graduates, but applications from suitable candidates holding H.N.C. will be considered. Previous experience in one or more of the above fields is desirable, but not essential.

7. Technical assistant for gearbox development. The work entails the preparation of test schedules, development work on aero engine auxiliary gearboxes and the preparation of reports on tests.
8. Junior test engineer for work on the development of miscellaneous hydraulic components for aircraft.
9. Junior test engineer for work on the development of aircraft landing gear.
10. Laboratory assistant for general electronic wiring and test duties on guided weapon programme.
11. Laboratory assistant for general rig wiring and test duties on electro hydraulic components.
12. Laboratory assistant, Inter B.Sc standard for metallurgical analysis.
13. Senior, intermediate and junior draughtsmen for design work on aircraft components.
14. Senior jig and tool draughtsmen.
15. Process planning engineers.

MINIMUM qualifications for vacancies 7-15, O.N.C. in the appropriate subjects. Previous experience in the aircraft industry desirable.

16. Modification draughtsmen, D.I.S. clerks and technical clerks.

THE above appointments offer interesting and progressive positions to men of suitable qualifications and experience. The factory is pleasantly situated between Gloucester and Cheltenham and working conditions are good. Superannuation and welfare schemes are in operation.

APPLICATIONS, giving details of age, education, training and experience, and salary required, specifying the vacancy for which application is made, should be addressed to the Personnel Manager, Messrs. Rotol/British Messier Limited, Cheltenham Road, Gloucester. [2673

AIRWORK GENERAL TRADING CO., LTD.

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3. Licensed radio engineers and inspectors with category "A" and/or "D" endorsements.
4. Licensed instrument engineers and inspectors with category "X" endorsement.

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4. Radio mechanics.
5. Instrument mechanics.

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THE COLLEGE OF AERONAUTICS

APPLICATIONS are invited for the post of Lecturer in the Department of Aircraft Propulsion. Candidates should have advanced knowledge of some branch of thermodynamics or gas dynamics, and of the theory and performance of propulsion units, and some practical experience of one or more modern propulsion systems. They should possess a degree and/or other recognised professional qualification. Salary within range £600-£1,000 per annum depending upon qualifications and experience, with superannuation under F.S.S.U., and family allowance. A small house on the college estate may be made available.—Applications, giving full details of qualifications, etc., and quoting the names of three referees should be addressed to the Recorder, The College of Aeronautics, Cranfield, Bletchley, Bucks. Further particulars available. Closing date for applications, November 12, 1954. [2747

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A MAJOR guided weapons contractor has three vacancies in the structures and aerodynamics departments.

ONE stressman is required of Degree or H.N.C. standard, with previous experience of aircraft stressing and structural design desirable. Candidates who have completed an engineering apprenticeship will be given preference.

DUTIES include structural design and test work planning of missile airframes, together with development of new methods of fabrication.

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DUTIES include aerodynamic design of missile airframes, performance and control investigations, theoretical aerodynamic studies and planning of wind tunnel and flight tests.

APPLICANTS should have no National Service commitments.

SALARIES and prospects of promotion on merit are excellent. Good working conditions, pensions scheme and welfare facilities.

APPLICATIONS, quoting D.O.24, giving details of age, experience, qualifications and salary required, should be addressed to the Personnel Manager, Aircraft Division, Bristol Aeroplane Company Limited, Filton House, Bristol. [2723

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DESIGNER-DRAUGHTSMEN

ELLIOTT BROTHERS (LONDON) Ltd., Guided Weapons Division, require designer-draughtsmen for the design of electronic equipment or small electro-mechanical and hydraulic mechanisms. Applicants should have H.N.C. and workshop and drawing office experience. Experience of practical layout from circuit diagrams or miniaturisation and potting techniques is desirable.—Applications, giving details of age, education, training and experience, should be made to the Personnel Officer, Elliott Brothers (London) Ltd., Elstree Way, Borehamwood, Herts, quoting Ref. 390. [2751

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A RAPIDLY expanding precision instrument manufacturing firm holding long term design and development contracts has a vacancy in its aerodynamics department for very interesting work on auto-pilots. Good salary and excellent prospects for a man of degree standard or equivalent. Previous experience not essential.

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HISPANO SUIZA'S English associate, British Manufacture and Research Co., Ltd., of Grantham, urgently require a first-class technical artist for the preparation of exploded and sectioned illustrations on light gunnery and fire control equipment.

THE successful applicant will require to have had extensive experience of all aspects of technical illustrating and to have a sound knowledge of all mediums, including scraper board and air brush.

THE Company offers excellent sports and welfare facilities and a voluntary pension and life assurance scheme after a qualifying period.—Applications, with personal details, qualifications, age, experience, and salary required, to British M.A.R. Co., Ltd., Grantham, Lincs., quoting reference AWK/CAHP/Staff E. [2696

DOWTY HYDRAULIC UNITS, Ltd., invite application for senior and junior post in their design office, on a varied and rapidly expanding programme of work on commercial hydraulic equipment.

KNOWLEDGE of light hydraulics is desirable, but draughtsmen with precision engineering experience also suitable.

WORKING conditions and prospects for advancement are good and the firm has a realistic pension scheme.—Apply to Personnel Department, Dowty Hydraulic Units, Ltd., Ashchurch, Glos. [2726

SENIOR planning engineer for aircraft works. Experienced in experimental and production planning. Must be able to take charge of section.—Full details to Box 8525. [2776

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A. J. W. (INSTRUMENTS), Ltd. Vacancies for experienced instrument mechanics. Interesting and varied work on automatic pilots, gyro, electric and physical instruments.—Apply to A.J.W. (Instruments), Ltd., Gatwick Airport, Horley, Surrey. [0270

TECHNICAL assistant required, age 20-25, H.N.C. or equivalent, for interesting work in heat exchange test dept.—Apply, giving age, experience and salary required, to Delaney Gallay Ltd., Vulcan Works, Edgware Road, Cricklewood, N.W.2. [2759

NORMALAIR LTD., have vacancies in Yeovil for design draughtsmen, D.O. checkers, technicians, stressmen, liaison engineers, for work on aircraft pressurising and high altitude breathing equipment and cold air units.

DESIGN draughtsmen are also required for the Cricklewood office. Generous superannuation scheme, excellent prospects, rapidly expanding organisation.—Applications, stating age, experience, qualifications and salary required, to: Personnel Officer, Normalair Ltd., Yeovil, Somerset.

LOCAL interviews arranged where convenient. [0346

CHIEF Stressman is required by Normalair, Ltd., to be responsible for strength calculations in connection with aircraft pressurising and air conditioning equipment, including cold air units and high altitude breathing equipment, and other new projects. An engineering degree or equivalent is essential.

APPLICATIONS, stating age, experience, qualifications and salary required, are to be addressed in the first instance to the Personnel Officer, Normalair, Ltd., Yeovil. [0347

THE ENGLISH ELECTRIC CO., Ltd., Luton, require a junior engineer with a degree or H.N.C. in mechanical engineering to assist in the design of guided missile rocket motors. Apply to Dept. C.P.S., 336-7 Strand, W.C.2, quoting Ref. 1325E. [2770

EX-R.A.F. and F.A.A. radio, radar and wireless fitters or mechanics required for interesting work as wiremen on flight simulators. Housing accommodation at Crawley New Town may be available in the future for satisfactory applicants. Apply 59, Webber St., S.E.1. WAT: 3536. [2771

WANTED, designer-draughtsmen for sales development work designing structures in light metals. Must possess or be aiming for Higher National Certificate. Location, Banbury, Oxon. Salary up to £780, depending on age, experience and qualifications. Prospects of eventual promotion from drawing-board. Pension plan in operation.—Send full particulars of previous experience to Northern Aluminium Co. Ltd., Bush House, Aldwych, London, W.C.2. [2774

DESIGN draughtsmen, all grades, urgently required on electrical and electronic apparatus for guided weapons and allied projects.—Please write in detail, or send postcard for application form, to the Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [0611

WANTED: fully qualified flying instructor, not under 25, for instruction on Austers, Tiger Moths and Proctors with commercial licence endorsed for Proctors and Austers. Accommodation available for single man. Permanency for suitable applicant. Ex-Naval Instructor preferred.—Box 8264. [2705

ARMSTRONG SIDDELEY MOTORS have a vacancy in their technical illustrating department for an experienced technical artist, aged 24-26. Staff position, salary according to age, experience and qualifications. Replies should be addressed to Reference CG/TA1, Armstrong Siddeley Motors, Coventry. [2722

ENGINEERING COMPANY (employing 60 personnel) engaged upon manufacture of aircraft ground equipment require to appoint an inspector to assume full responsibility for inspecting to A.I.D. Standards. Factory located in Southern England. Write Box 8311. [2716

SAUNDERS-ROE, Ltd., have vacancies for a limited number of experienced aircraft draughtsmen in their design office at Osborne, I.W.—Applicants must have several years' experience of designing aircraft structures and should possess at least an Ordinary National Certificate.

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APPLY, stating age, experience, etc., and quoting ref. F/12 to Personnel Officer, Saunders-Roe Limited, East Cowes, Isle of Wight. [2694

RADIO mechanics, licensed and unlicensed, are urgently required by Field Aircraft Services, Ltd., at the Newcastle base. Applications, giving fullest detail of experience and qualifications if any.—Please address to the Personnel Officer, F.A.S. Ltd., Croydon Airport, Surrey. [2670

DESIGNERS and intermediate draughtsmen are needed in our aero division office. Interesting and varied work on aircraft fuel system components. Previous aircraft experience an advantage but not essential. H.N.C. and O.N.C. standard. The openings offer permanent positions with good prospects for the right men. Congenial working conditions in the beautiful Wye Valley.—Applications, stating qualifications, age and experience, to Chief Engineer, Saunders Valve Co., Ltd. (Aero Division), Hereford. [2750

FIRST-CLASS mechanical design draughtsmen are required for interesting and important projects.—Please write in detail or send postcard for application form to The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [0610

DRAUGHTSMEN, sound experience aircraft structures, urgently required for interesting work in London and Portsmouth areas by large engineering organisation. Salary £12 per week upwards plus a living allowance if from outside the district. Pension scheme.—Please write, giving full particulars of experience and qualifications, to Box 8360. [2736

DESIGN draughtsman required to work on conversion and repair of aircraft. Must be capable to work on own initiative, some knowledge of stress analysis or design of interior furnishings an advantage. Salary commensurate with experience and ability.—Please apply to the Personnel Office, Field Aircraft Services Ltd., Nottingham Aerodrome, Tollerton, Nottingham. [2760

DRAUGHTSMEN, sound experience aircraft electrical work, urgently required for interesting work in London and Portsmouth areas by large engineering organisation. Salary £12 per week upwards plus living allowance if from outside the district. Pension scheme.—Please write, giving full particulars of experience and qualifications, to Box 8361. [2737

ENGINEER required by Guided Weapons firm near London for work involving many aspects of missile dynamics and flight trials. Experience in aerodynamics essential. Good degree, age about 24/27 and several years' experience in aircraft or missile industry required.—Write, in confidence, to Box AC 00328, Samson Clarks, 57/61 Mortimer Street, W.1. [2702

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fordhouses, Wolverhampton. [0420

JOSEPH LUCAS (GAS TURBINE EQUIPMENT) Ltd. invite applications for technical vacancies in the engineering development laboratory at our Marston Green and Shaftmoor Lane factories. Applicants should possess Higher National Certificate or an engineering degree, or equivalent. These appointments are pensionable and offer good prospects to individuals with initiative and technical ability. Salary in accordance with experience and qualifications.—Details of experience and qualifications should be sent to the Personnel Manager, Joseph Lucas (Gas Turbine Equipment) Ltd., Shaftmoor Lane, Hall Green, Birmingham 28. [2753

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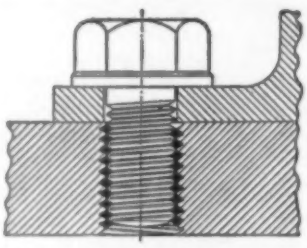

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DRAUGHTSMEN required for interesting work at experimental airfield in connection with the installation of test equipment in the latest types of aeroplanes. Previous aircraft experience preferred.—Write, stating age, salary required, etc., to: Personnel Dept., Vickers-Armstrongs Ltd., Supermarine Works, Hursley Park, Nr. Winchester, Hants. [2727

DRAUGHTSMEN required in the designs drawing office. These appointments are pensionable and offer good prospects to individuals with initiative and technical ability.—Applications, giving details of experience and qualifications, should be sent to the Personnel Manager, Joseph Lucas (Gas Turbine Equipment) Ltd., Shaftmoor Lane, Hall Green, Birmingham 28. [2752

VACANCIES exist in the Installation Department of Smiths Aircraft Instruments, Ltd., Cheltenham, for Aeronautical or Electrical Engineers having experience of electric and hydraulic servo mechanisms, radio navigation equipment, gyro magnetic compasses and experimental flight testing. A good general knowledge of aircraft construction and operation is essential.

APPLICANTS should hold a degree or the equivalent, have a medical standard equal to Class "A" Life Insurance, and should be willing to travel within the U.K. and abroad.

THE starting salary will depend on qualifications, age and experience.

APPLICATIONS, with details of qualifications, experience and salary required, should be made in writing to the Personnel Department, Smiths Aircraft Instruments Limited, Bishops Cleeve, near Cheltenham, Glos., quoting reference number 42/EN. [2742

ESTIMATOR required by rapidly expanding light engineering works engaged in high altitude oxygen and other equipment in South West England. Must be capable of working on own initiative. Excellent prospects with pension scheme. Write, giving full details of previous experience and salary required to Box RK 3728, AK Advg. Ltd., 212a Shaftesbury Ave., London W.C.2, quoting 13N/954. [2713

HOUSING assistance will be offered to chargehand fitter with wide production experience of aircraft-type hydraulic installations, required by manufacturers of materials handling vehicles. Pleasant country district one hour London. Good prospects for advancement. Canteen and social facilities.—Please write, giving details of past experience, present salary, salary required, married/single, to Box 8480. [2761

HELLIWELLS Ltd., Aircraft Division, Elmdon Airport, Birmingham, urgently require draughtsmen, all grades, preferably with aircraft installation experience, but others with good light engineering experience considered. The work is interesting and of high priority, and good opportunities of advancement with this expanding company are open to the right men. —Send full details to Personnel Manager. [2749

ARMSTRONG SIDDELEY MOTORS require young engineers interested in tests covering performance measurement, handling control behaviour, analysis of flight test data, prediction of engine performance and the functional side of engine behaviour. Applicants must possess a Degree or Higher National Certificate. Application to Reference CG/FP2, Technical Personnel Manager, Armstrong Siddeley Motors, Coventry. [2721

AERO engine service representative required. Applicants must be qualified at least up to D licence standard. Experience on jet engines an advantage, but not essential. A single man is preferred, who must be willing to travel abroad. This is a staff position with pension and life assurance scheme. Write giving full particulars and marking envelope "Service Representative," to Box F.424, c/o 191, Gresham House, E.C.2. [2765

SENIOR and intermediate design draughtsmen required to take part in an interesting long-term development. Applications will be welcomed from engineers with experience of the design of servo mechanisms and light engineering. Five-day week. Excellent canteen. Special transport facilities from Salisbury, Ringwood, Christchurch, Bournemouth and Poole.—Apply, in writing, to Personnel Manager, Flight Refuelling, Ltd., Tarrant Rushton Airfield, nr. Blandford, Dorset. [2740

BRITISH OVERSEAS AIRWAYS CORPORATION have vacancies for engineer officers (flight engineers). Applicants must be between 21 and 35 years of age, of a high standard of physical fitness and educated to School Certificate standard. The qualifications required are five years' experience in aircraft maintenance, including both airframes and engines on four-engined aircraft; or an apprenticeship in aeronautical engineering with an additional two years' practical experience or two years' experience as a pilot or flight engineer on four-engined aircraft with adequate practical engineering experience in addition. Desirable additional qualifications are the possession of maintenance engineer's licence in categories A and/or C on four-engined aircraft, and in any case applicants will be expected to have the technical knowledge necessary to obtain such licences. Successful candidates will be appointed for a probationary period which will include training to enable them to obtain the flight engineer's "O" licence, and during this time a salary within the range of £600-£700 per annum will be paid. On confirmation as an engineer officer a commencing salary of £805 per annum will be paid, rising to a maximum of £1,345 per annum.—Applications should be addressed to the Chief Personnel Officer, B.O.A.C., Airways House, Great West Road, Brentford, Middlesex. [2748

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with Higher National Certificate or Degree for interesting work on aircraft undercarriages and hydraulics.

DRAUGHTSMEN

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SITUATIONS VACANT

TECHNICAL representative required to promote sale of synchro and servo equipment. Applicants should have previous engineering experience on electronics, servo mechanisms and radio navigational devices. This appointment which is pensionable offers excellent prospects to an individual with initiative and technical ability. Applications, giving full details of age, qualifications and experience, should be addressed to Smiths Aircraft Instruments, Ltd., Cricklewood, London, N.W.2. Ref. SAI/TS2a. [2764

TEST observers required in the Engine Division Development Department in connection with Engine Test and Performance analysis. Work is interesting and offers scope for advancement. Minimum qualification H.N.C. Mechanical Engineering. Good opportunity for young qualified engineers who have completed National Service. Good working conditions and pension scheme. Apply, quoting E.D.16, and giving particulars of qualifications, experience and age, to:—The Personnel Manager, Bristol Aeroplane Company, Ltd., Engine Divison, Filton House, Bristol. [2744

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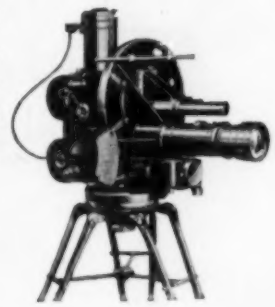

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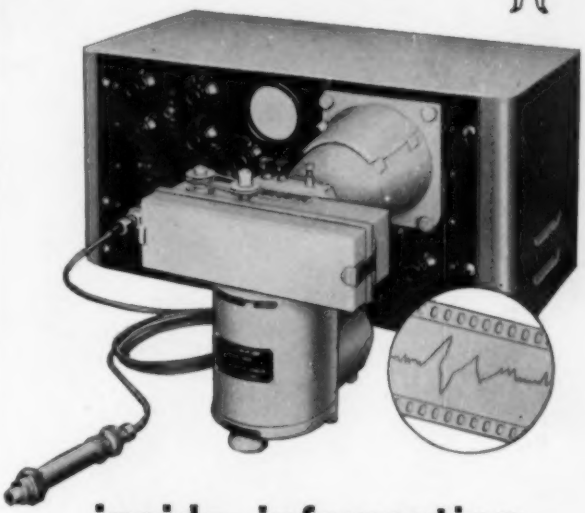

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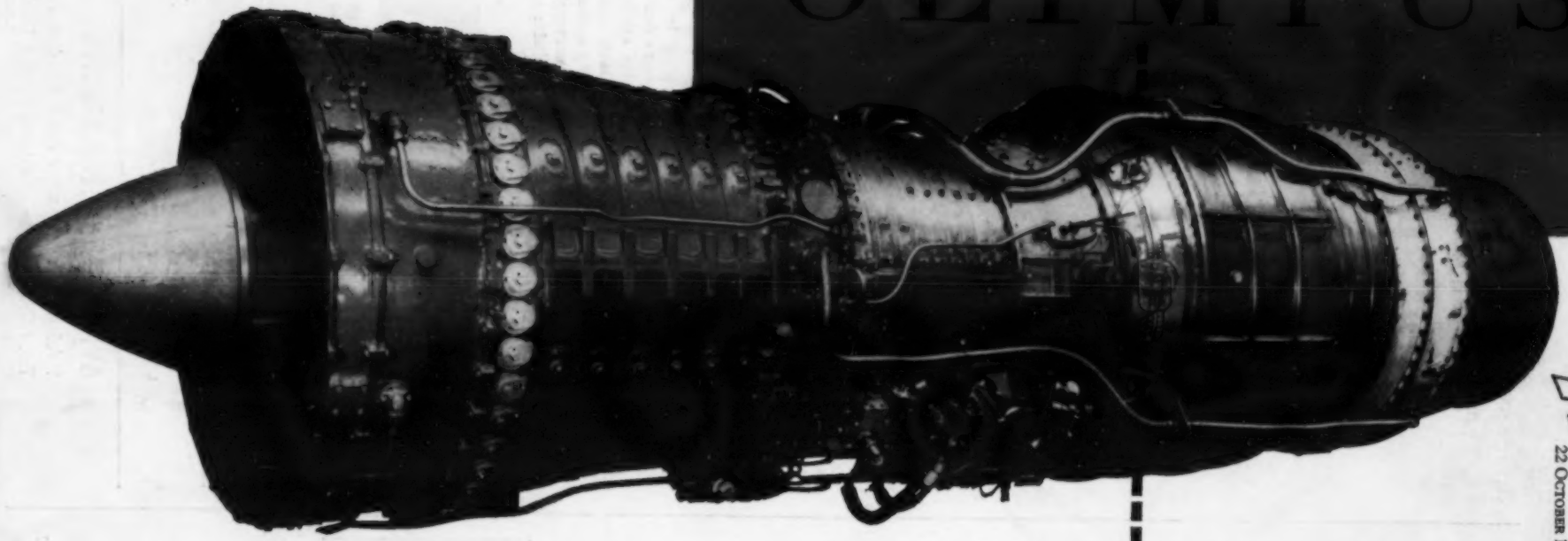

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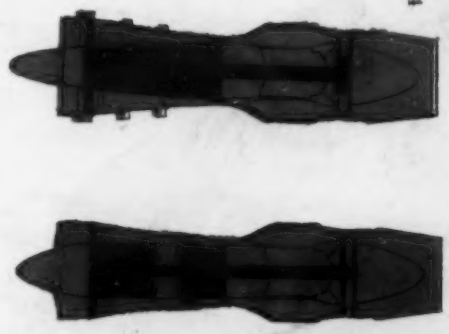

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